AN OVERVIEW AND HISTORY
OF THE
MEASURES FOR
ENERGY-EFFICIENT NORTHERN HOUSING

Prepared by Larsson Consulting for
Energy, Mines and Resources Canada

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1: Introduction and Background

The Measures for Energy-Efficient Northern Housing (or Northern Measures) contains draft energy-oriented building requirements intended to be suitable for residential construction in the North, including the Northwest Territories, the Yukon and those portions of provinces which experience permafrost. The Northern Measures has been prepared by an intergovernmental and interdepartmental committee under the general direction of Energy, Mines and Resources Canada.

The broad terms of reference for the task of preparing the Northern Measures were established by the federal government, through the Treasury Board. The Treasury Board instructions stated that a standard was to be produced in time for the 1984 building season, and that the federal government would thereafter require all residential buildings falling within its jurisdiction to be constructed according to the standard.

Energy, Mines and Resources Canada (EMR) was assigned the lead role in the task, and consequently established the Northern Residential Standards Committee in 1982. EMR solicited the active participation of the Territorial and provincial governments on the committee, as well as those federal departments with a major interest in the North. Considerable emphasis was also placed on obtaining the involvement of private-sector designers, builders and organizations. The result was a three-level structure, including an Advisory Committee, a Technical Committee and a small working Technical Subcommittee. The head of the Secretariat for the project was an EMR official located in Yellowknife, who was provided with support by a consultant technical advisor in Ottawa.

The goal of the project was to produce a residential construction standard which would result in significant energy savings in new housing built in the North. An early decision was made to broaden this mandate to cover a broad range of construction problems unique to the North on the basis that it is not sensible to increase energy efficiency if other factors that can lead to the rapid deterioration of the building fabric are not addressed.

As the project evolved, it became apparent that it would be premature to designate these proposed requirements as a standard. This led to the use of the term "measures" and a decision to distribute the document for comment by design professionals, builders and other potential users during a 2-year review period ending in December, 1986. The current document is therefore not intended to be used directly, but rather to serve as a discussion document to generate comment, which in turn may lead authorities having jurisdiction to adopt it as a standard after it has been finalized.

Energy Mines and Resources Canada intends to elicit comments from key public and private-sector organizations and individuals during the review period and to prepare a discussion paper in early 1987 summarizing reactions to the Northern Measures and suggesting possible implementation plans.

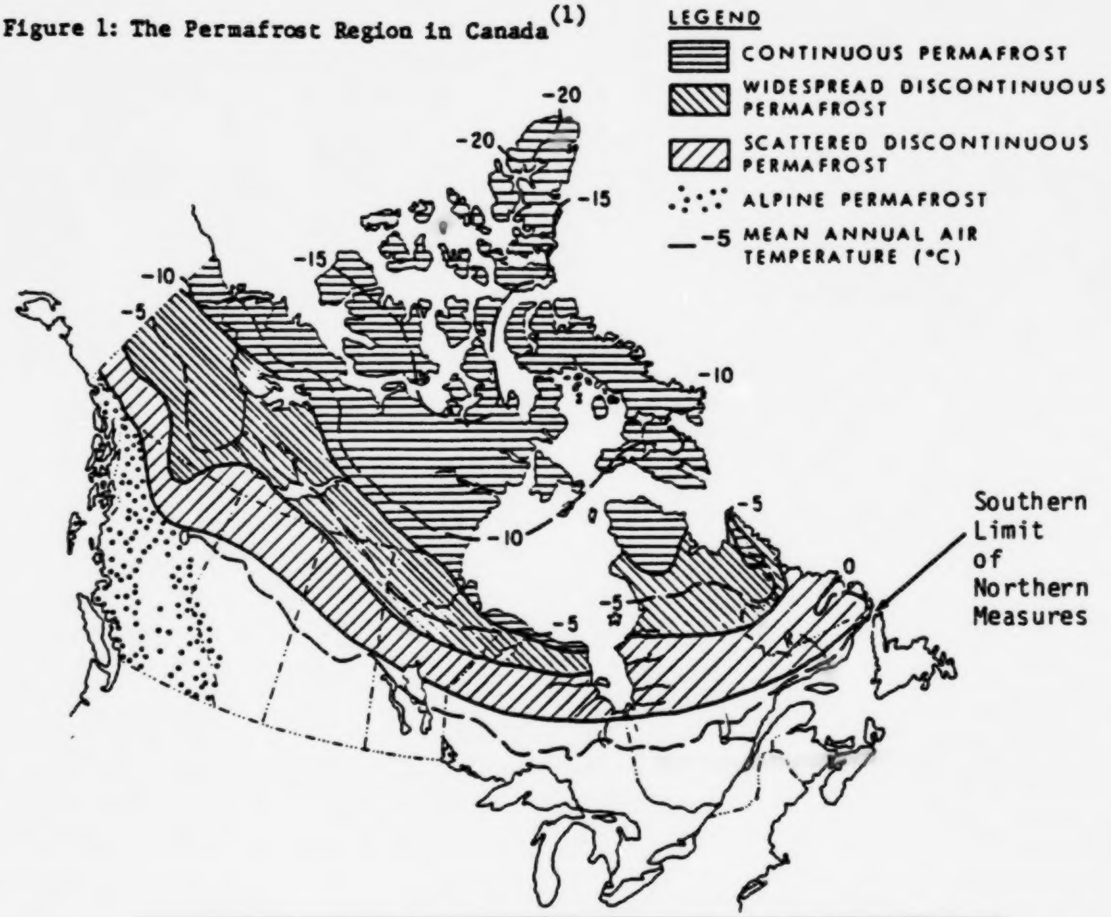
A two-stage process will be used in which reviewers are asked to forward to EMR their initial comments by January 31, 1986 based on their review and/or use of the Northern Measures to design homes for the 1986 construction season. In addition, reviewers are being asked to provide final comments by Dec. 31, 1986 based on their experiences with the construction of homes designed to the Northern Measures during the 1986 construction season.

2. A Working Definition of the North

The terms "North" and "northern housing" are frequently used in the Northern Measures. Although some would argue that all Canadian locations are northern, the long periods of extreme cold and the permafrost soils of this region are clearly different from conditions in most parts of the ten provinces. The Northern Measures is therefore designed to apply to the area north of the southern limit of the zone of scattered discontinuous permafrost.

As Figure 1 indicates, the zone in question takes in all parts of the two Territories and a significant portion of the provinces, but it must be emphasized that the line is not an exact one. It will also be seen that the boundary line bears some relationship to the isotherms of mean annual air temperature, but that the relationship is by no means a perfect one.

Figure 1: The Permafrost Region in Canada(1)


LEGEND
▤ CONTINUOUS PERMAFROST
▧ WIDESPREAD DISCONTINUOUS PERMAFROST
▨ SCATTERED DISCONTINUOUS PERMAFROST
∴ ALPINE PERMAFROST
—5 MEAN ANNUAL AIR TEMPERATURE (°C)
-20
-20
-15
-15
-10
-5
-10
-10
-5
0
-5
-5
0
0
Southern Limit of Northern Measures

3. The Need for the Northern Measures

The severe climatic conditions of the North are largely responsible for the high level of per-capita energy consumption in that region. The absence of locally available forms of energy and the high cost of transporting fuels to many areas, especially to the Northwest Territories, aggravate the problem, with the result that the average cost of fuel for space heating and generation of electricity in NWT is the highest in Canada. The problem, however, is not only one of climate, but extends to the type and quality of housing which has been built in the North over a period of many years.

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(1) Source: Johnston, G.H., Ed., Permafrost Engineering, John Wiley & Sons, Rexdale, Ontario, 1981

Prior to the last two decades, only a few houses were built in the North. In general, they were reasonably well built and provided adequate shelter as long as fuel was cheap and available. Native people tended to live as they had always had, in tents and temporary shelters.

In the 1950s, government policies were introduced which resulted in a crash program to build more "Canadian"-style houses for both native and non-native people living in the North. Hundreds of small, simple, prefabricated plywood houses were built in the south and shipped north for assembly. For want of better knowledge and experience, design and technology were strictly "southern", workmanship was poor and the severe northern climate soon made its effects apparent on the buildings.

The 4000 or so public housing units located in NWT provide an excellent example of the problem, in that there was an estimated annual average outlay in 1981 of about $4150 per unit for energy subsidy costs alone. The extremely high energy cost is undoubtedly partially due to the high cost of fuel in the North and the absence of incentives for individual tenants to conserve energy (rents bear little relationship to actual energy costs), but it also reflects a more general problem: the absence of energy standards at the time they were built and the unsuitability of the general design and construction standards which were in force at the time. The overall result has been the establishment of a housing stock with poor longevity and very poor energy performance.

Despite this poor record, a considerable body of knowledge has been accumulated by both public and private designers and builders. It is therefore now possible to specify designs and construction techniques which will result in durable and energy-efficient housing. This is in fact being done by a number of public agencies, such as the NWT Housing Corporation and the Quebec Housing Corporation, and by some private builders, but the problem which remains is to ensure that this knowledge is transmitted to all those who design and build in the North, so that the general quality of construction can be improved in the very near future.

Recognition of this situation led the federal government to decide to produce the Northern Measures as a first step. In addition to the Northern Measures, a variety of other approaches may have to be adopted to provide a satisfactory degree of improvement in the situation, including the development of standards and manuals of good practice, training, demonstrations and incentives. The Northern Measures is therefore only one of many methods which can address the problem, but it may be one of the most important in those jurisdictions where it is eventually adopted as a requirement. The most important issues that remain to be resolved are, firstly, the process of adopting the Measures, and secondly, the need to ensure its on-going maintenance.

4. Principles Followed in Preparing the Northern Measures

The following points summarize the principles followed by the working sub-committee in preparing draft clauses for the Northern Measures:

1. The chief objective is to reduce the amount of energy used in the operation of small residential buildings.
2. A secondary objective is to use the Northern Measures as a vehicle for setting an acceptable lower limit for the general standard of building construction.
3. The requirements of energy efficiency cannot be allowed to compromise the safety of the occupants.
4. Cost-effectiveness must be an important consideration.
5. Interpretation and use of the Northern Measures must not be too heavily dependent on access to engineers or sophisticated analytical techniques.
6. Equipment and systems that are required must be certified, trouble-free and readily available.
7. Attempts must be made to achieve a balance between the flexibility made possible by performance standards and the clarity resulting from the use of prescriptive standards.

5. Structure of the Northern Measures

It was decided to base the Northern Measures as closely as possible on the "Residential Standards, Canada 1980", a CMHC document with which most Canadian designers and builders are very familiar. Another major element in the new Measures is the inclusion of almost all of the changes which are included in the 1985 National Building Code. In summary, the Northern Measures contains much that is new, especially in Sections 5, 15, 16, 19, 26, 32, 33, 34 and 40, while many other sections contain at least a few changes.

6. A Simplified Overview of Northern Measures Requirements

The preparation of a standard (or, in this case, a Measure) is not a cut-and-dried affair. A requirement can be performance-oriented ("... the bedroom shall provide for sleeping and clothes storage for two adults ...") or it can be prescriptive (" ... the bedroom shall have a minimum area of 9.8 m^2 and a minimum dimension of 2 m, and the closet shall...."). Usually, requirements are a mixture of both, since performance criteria leave the designer with options in reaching a solution, whereas prescriptive statements have the virtue of clarity and ease of enforceability.

The energy-related provisions of the Northern Measures are primarily prescriptive, with some provision for performance criteria. The Northern Measures provides a compartmentalized approach, with no trade-offs being permitted between the thermal performance of walls and the performance of furnaces or the provision of heat recovery equipment. Trade-offs are permitted between glazing and the opaque envelope, as long as the average performance of the above-grade envelope remains at the same level. The rationale for this approach is that, whereas the envelope and glazing tend to be permanent features of the building, the continued presence or efficiency of heating or heat recovery equipment cannot be guaranteed.

Thermal Insulation

One of the most important features of the Northern Measures is the use of a table of minimum RSI values for the above-grade building envelope. The table is based on an economic optimization formula, and allows the designer the choice of using the table alone or using the full formula upon which the simplified table is based. The full formula leads the user to select the most cost-effective level of average thermal performance of the envelope, given the following data:

1. Degree-day regime of the area
2. Incremental cost of adding insulation
3. Cost of fuel

The simplified table is based on the same factors, but makes the assumption that the cost of fuel will always be 10% of the incremental cost of improving the thermal resistance of a wall area of 1.0 m^2 by RSI 1.0. The values in the simplified formula will be referred to by most users of the Northern Measures, but if the Northern Measures were to be adopted, the authority having jurisdiction would always retain the option of implementing the full formula.

A unique aspect of this approach is that it provides an RSI value which is the same for all assemblies above grade, whereas conventional systems provide for greater RSI levels in roofs and exposed floors. The Northern Measures requirement is based on the premise that the trend towards using similar structural sections for walls, floors and cathedral roofs in northern construction makes it sensible to specify the same RSI values for each situation.

Foundation walls below grade have been treated as a separate problem, since heat losses in this case do not vary with degree-day regimes in a consistent manner.

Despite the single minimum RSI value produced by use of the R-optimum (R_{opt}) approach, designers are, of course, free to improve the performance of various parts of the envelope, such as the roof. This may be to the designer's advantage, since another provision allows trade-offs to be made in envelope performance between various envelope sections, including glazed areas. In this regard, it should be noted that the minimum glazed area (for light) has been reduced from the 1980 CMHC Residential Standards (RS 1980), and a maximum glazed area has been established, along with an incentive to provide south-facing glazing.

The final basic element in the Northern Measures approach is an absolute minimum RSI value of 5.0, a figure which must be reached by all above-grade assemblies despite the operation of the trade-off provision.

Airtightness and Ventilation

One of the largest energy requirements in a relatively well-insulated building is that of heating air introduced for ventilation or as a result of infiltration/exfiltration processes. The Northern Measures has approached this problem by requiring a high degree of airtightness accompanied by a requirement for a controlled rate of mechanical ventilation.

If mechanical ventilation is used, the system must be able to provide up to 1.0 air changes per hour (ach) during normal operation, a requirement which is in accord with National Building Code provisions.

Heat recovery devices constitute an important potential method of reducing the net amount of heat energy lost due to air exchange. The Technical Committee came to the conclusion that this type of equipment is not yet developed to the point where it should be required in the Northern Measures. A few clauses have been introduced to deal with the voluntary use of this type of equipment, the most important being that heat recovery systems must not unbalance the ventilation system or reduce ventilation performance in the event of breakdown.

Combustion Equipment

Differentiation is made between combustion appliances that require the use of a flue and those that do not (gas stoves, refrigerators). Many of the requirements for isolation of equipment apply only to appliances with flues.

Combustion appliances are required to be isolated from living spaces, either by the design of the appliances themselves, or by placing them in a combustion equipment room, so that combustion products cannot be drawn into the living spaces. This has been achieved by placing restrictions on interaction between the appliance and the living spaces in both Section 33 and Section 34.

Fireplaces and solid-fuel stoves are permitted if they conform to the isolation requirements and are provided with direct external air for combustion.

Glazing

Glazing requirements are a blend of 1985 NBC and 1983 NRC Energy Measures requirements, with some strengthening of both. The NBC requirements for **minimum** glazed areas have been reduced; and while the NRC Energy Measures approach to a **maximum** area of glazing has been followed, the areas are reduced. As in the NRC Measures, south-facing glazing is given preference, a trade-off with the performance of the solid envelope is permitted, and minimum RSI values are specified for glazing.

Requirements for thermal performance and airtightness of windows and doors have been increased over RS 1980 and NRC Energy Measures requirements.

Other Items

1. Roof ventilation requirements take into account the increased airtightness of the envelope which is now required, and the special problems posed by areas with blowing snow.
2. New provisions for soil drainage and foundation design should ensure successful construction in permafrost conditions.
3. Plumbing requirements have been revised to take into account the widespread use of water and sewage holding tanks in the North.
4. Many provisions have been added to improve general construction and design practices. Some of these originate with the Technical Committee, but many more are adopted from revisions to the 1985 National Building Code.

To obtain further information, please call or write to the EMR Conservation and Renewable Energy Office located in your province or territory.

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Energy, Mines and
Resources Canada

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Measures for Energy-Efficient Northern Housing

(Commentary)

DRAFT

Canada

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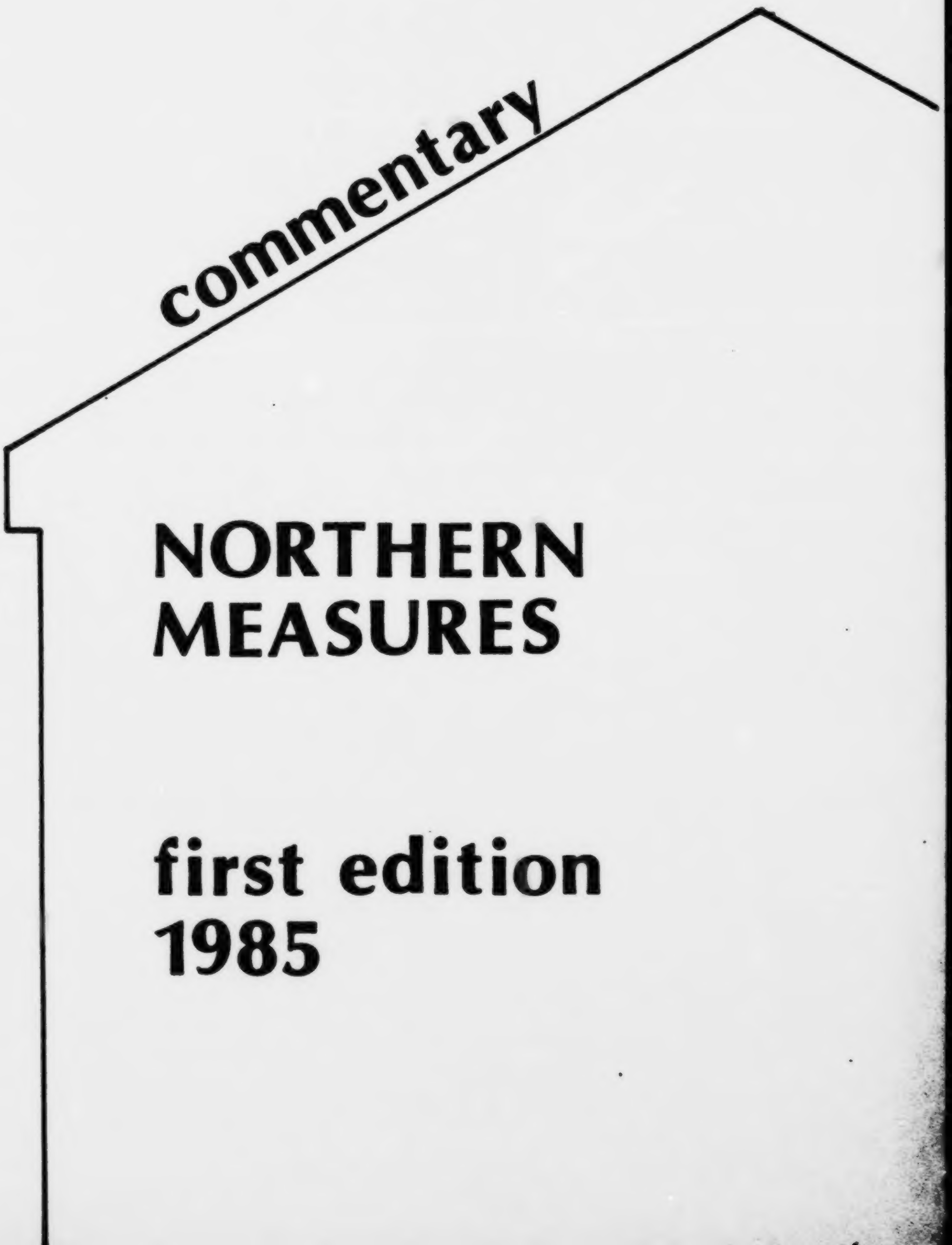
ENERGY EFFICIENT
NORTHERN HOUSING
(Commentary)



commentary

NORTHERN MEASURES

first edition
1985

COMMENTARY

SECTION 1: GENERAL

A(7) The need for an operating manual to describe the systems in the building is one which is becoming imperative for all housing, North or South. Mechanical, electrical and ventilation systems have become increasingly complex, and improper operation in dwellings which are essentially air-tight can lead to very inefficient operation and unsafe conditions. In the North, sewage and water systems are added to the list of systems which depend on intervention by the occupant for their proper operation; and the consequences of a malfunction in these areas are severe and long-lasting.

SECTION 2: DEFINITIONS

As a general rule, the Northern Measures uses definitions developed in the Residential Standards and the National Building Code. New definitions have been added only where required for specific Northern Measures applications. Otherwise, reference should be made to the comprehensive definitions contained in the NBC as has been past practise.

Active layer is the first of several new definitions which reflect the unique environmental conditions of the North.

Other new terms have been provided to deal with issues of air movement and the prevention of condensation, including **air barrier, vapour barrier and air-vapour barrier**. The use of these three terms also reflects the fact that, although most use is made of air-vapour barriers, only an air barrier is required to prevent the movement of air between a combustion equipment room and the rest of the dwelling. Another reason for providing separate terms is that an air-vapour barrier can be constructed by combining two adjacent layers, one performing the air barrier function and the other the vapour barrier function.

The term **appliance** is one which is taken from the NBC. It is not an ideal term, since it can easily be confused with the commonly used "kitchen appliance". In the NBC sense, however, the term only refers to systems and equipment that convert fuel into energy, thereby excluding, for example, electrically- operated stoves or furnaces. The principles followed in Sections 33 and 34 of the Northern Measures require that a distinction be made between equipment that uses air for combustion and equipment that does not. In view of this need, and the desire to maintain consistency with the NBC, the term has been adopted.

Another important new definition is **building envelope**. This term has been added to reflect the increasing need to differentiate between exterior walls which contain insulation and an air-vapour barrier, and those which do not.

The terms **chimney, combustible and combustible construction** have been added from the NBC for ease of reference. It was found that although the term **chimney flue** has been used in the RS 1980 and the NBC, it is not a defined term; a definition was therefore added.

The NBC and the RS 1980 contain a definition for service rooms, and reference is made in those standards to various special-purpose service rooms, such as furnace rooms, incinerator rooms, and equipment rooms. The Northern Measures places emphasis on special requirements for service rooms that contain appliances (fuel-fired combustion equipment). The term **combustion equipment room** was therefore defined to refer to this type of room, and **utility room** is used to refer to a service room that contains non-combustion equipment. The term **service room** has been kept intact, so that both combustion equipment rooms and utility rooms are now defined as special-purpose service rooms.

Flue pipe and **grade** are NBC terms added here for ease of reference.

Although the term **heated space** would appear to have an obvious meaning, it was felt necessary to define it to cover instances where heating of a space occurs indirectly, as in the case, for example, of radiant losses from a hot-air duct passing through a space. The definition used is taken from the NRC Measures for Energy Conservation. The definition for **permafrost**, has been adopted from "Permafrost" issued by the Associate Committee for Geotechnical Research.

Vent closure and **weather barrier** have been added since the terms have been introduced in Section 26. It should be noted that the vent closure defined here has no relationship to the term "closure" already defined in the RS 1980.

SECTION 3: MATERIALS, SYSTEMS AND EQUIPMENT

This Section contains few changes. The draft 1985 NBC suggested changes to Subsection B, which have been adopted. The only substantial change is in Subsection C, dealing with the preservative treatment of lumber.

SECTION 4: STRUCTURAL REQUIREMENTS

This Section has been renamed in the 1985 draft NBC, and extensive changes have been proposed. All of the NBC changes have been included.

SECTION 5: ROOM AND SPACE DIMENSIONS

There has been little, if any, change in the space requirements of the Residential Standards for some forty years. This lack of change can be accounted for by two factors - first that their provisions have been acceptable to the majority of Canadians and second, and perhaps most significant, that they have been universally ignored by public and private developers who have exceeded the minimal space requirements as a matter of course. It is unlikely that most Canadians have seen, let alone lived in, houses built to minimum standards.

The Residential Standards were designed with a southern and urban orientation and have never been thoroughly satisfactory for northern or rural areas. An attempt was made to develop a northern version, which was published but quickly withdrawn after key items were incorporated in the Residential Standards. Since that time, minor modifications of the space standards have been permitted in the field in response to well defined problems, but there have been no major changes.

In preparing the Northern Measures, many sources of information were considered, including those aspects of northern practice which, while not required by the Residential Standards, have been adopted as norms by northern designers. Reports on northern housing workshops and conferences have also been assessed for features in northern houses most frequently described as being inadequate or inconvenient.

The difficulties encountered by disabled people are amplified in the North where long winters make outside movement extremely difficult for much of the year. Movement within a house can be restricted by narrow corridors and doorways (as it is in the South) but bathrooms that are raised a few steps to accommodate a sewage holding tank provide a special problem for disabled residents in the North. A(8)

It is recognized that many houses cannot be designed to permit easy movement inside by the disabled who live there with their families or who are visiting. The Northern Measures does, however, require that "wherever possible" wheelchair, access should be provided between a sleeping area or bedroom, a bathroom and the living room or area. A(8)

Space standards for the main activity areas of the dwelling - the living, dining and kitchen spaces - reflect the tendency of people in the North to be more house-bound than southerners during the winter time, and the greater emphasis northerners place on visiting between families and friends. The minimum areas of living and dining rooms and of kitchens have therefore been increased by 1 m^2 per bedroom for units that contain more than 2 bedrooms; a measure intended to reflect the additional demands placed on these facilities in dwellings with larger households. The Northern Measures retains the RS 1980 feature of permitting a reduction in the area of a living or dining room or kitchen where it is combined with another space. Subsections C, D & E

The small size specified for kitchens in RS 1980 appears to be especially inappropriate in the northern context, and the Northern Measures has therefore provided a substantial increase in its minimum size. The required counter space has also been increased and a requirement for the provision of shelving for the storage of bulk goods has been added. Subsection E

Table A provides a summary of the Northern Measures area requirements.

TABLE A **MINIMUM AREAS REQUIRED IN DWELLING UNITS ACCORDING TO THE NORTHERN MEASURES, in m^2**

	BACHELOR DWELLING	1 BEDROOM DWELLING	2 BEDROOM DWELLING	3 BEDROOM DWELLING	3 BDRM.+ DWELLING
LIVING ROOM	11.0	13.0	13.0	14.0	+1.0/BDRM.
DINING ROOM	4.0	6.0	6.0	7.0	+1.0/BDRM.
KITCHEN [1]	4.2	6.0	6.0	7.0	+1.0/BDRM.
LIVING COMB.	11.0	11.0	11.0	12.0	+1.0/BDRM.
DINING COMB.	3.0	5.0	5.0	6.0	+1.0/BDRM.
KITCHEN COMB.[1]	4.2	4.2	4.2	5.2	+1.0/BDRM.

1. Gross area, including space occupied by base cabinets

Subsections C, D, E & F

Although both the RS 1980 and the Northern Measures specify minimum areas and dimensions for the major rooms within a dwelling, neither standard specifies areas for hall, bathrooms or service rooms. Table B provides a more meaningful comparison between the total areas that would result from application of the Northern Measures and the RS 1980. A stock CMHC plan was used to provided the basis for comparison, and the original CMHC room areas are also shown. The Table demonstrates that, while the Northern Measures results in a unit that is 11.8% larger than the minimum required by RS 1980, it is smaller than the CMHC stock unit, which exceeds the minimum by 23.2%.

TABLE B: COMPARISON OF AREAS PROVIDED IN THE NORTHERN MEASURES, THE RS 1980 STANDARDS AND A STOCK CMHC HOUSE

Type of Space	Minimum as per RS 1980	Areas in CMHC Plan, m^2			Northern Measures, m^2		
		Area	Diff.	% diff.	Area	Diff.	% diff.
Living room	13.5	14.8	1.3	10%+	14.0	0.5	4%+
Dining/Kitchen	7.45	12.3	4.85	65%+	11.2	3.75	50%+
Bedroom 1	9.8	13.5	3.7	38%+	9.8	0.0	0%
Bedroom 2	7.0	9.8	2.8	40%+	7.0	0.0	0%
Bedroom 3	7.0	8.3	1.3	19%+	7.0	0.0	0%
Bathroom *	3.25	4.2	0.95	29%+	3.25	0.0	0%
Halls *	6.8	6.8	0.0	0%	6.8	0.0	0%
Clothes closets	1.65	2.9	1.25	76%+	1.65	0.0	0%
Linen closet *	0.16	0.3	0.14	88%+	0.16	0.0	0%
Coat closet	0.55	1.3	0.75	136%+	2(0.9)	1.25	227%+
Main vestibule	1.0	1.0	0.0	0%	2.25	1.25	125%+
Secondary vest. **	0.7	0.7	0.0	0%	2.25	1.55	221%+
Utility room * & general storage	stor. 5.7 total 5.7	10.9	see below		5.7 5.7	0.0	0%+
Combustion * Equipment Room	htg. 5.3 DHW 0.6 tank 0.0 total 5.9	included in utility room - total for both is 10.9, 0.7 or 6% less than RS total			5.3 0.6 0.0 5.9	0.0	0%+
TOTAL	70.46	86.8	16.34	23.2%+	78.78	8.12	11.8+%

* Indicates that, for the room indicated, there is no minimum area specified in the RS 1980 or the Northern Measures. In the case of the CMHC stock plan, the area provided was measured. For comparison purposes, areas used for the RS 1980 and the Northern Measures cases were built up from calculating the clearances which would be required around the necessary equipment or shelving area.

** There is no RS 1980 requirement for a secondary vestibule. The area used for the RS 1980 column is therefore based on the actual area provided in the CMHC stock house.

Note also that no provision has been made in any of the three units being compared for the internal location of oil, water or sewage tanks.

A coat closet will now be required for each entry vestibule, and in many cases there will be two entry vestibules per dwelling (as in the example used for Table B, since the gross ground floor area exceeded 75 m^2). One of the required closets can be omitted, however, if the space is added to the vestibule and if heavy duty coat hooks are provided in addition to those now called for in each vestibule. Subsection H

The only change proposed for the bathroom, apart from the new NBC requirement for a wider door, is in the provision of a lockable or child-proof cupboard for the storage of dangerous medicines or cleaning materials. Subsection J

Unlike the RS 1980, which only contains specific requirements for exit doors, the Northern Measures also contains requirements for entrances. The approach taken in the Northern Measures reflects widespread observations that two entrances are necessary, located on different faces of the building so that at least one entrance remains free of snow blockage. In addition, it was clear that, in most cases, an entrance is a distinct liability in terms of energy conservation unless it is provided with an unheated vestibule large enough to contain a bench and adequate coat closet or hanging space. The provision of two vestibules in a small unit imposes a planning and cost problem, and so the requirement has been made applicable only to units with a ground floor area of more than 75 m^2, thereby limiting its scope primarily to one storey units. Subsection L

The term "combustion equipment room" has been introduced to differentiate between a service room that contains fuel fired appliances and one that contains other types of mechanical or electrical equipment. The reason for the distinction is that the measures which have to be taken to assure safety and energy efficiency for combustion equipment require extra care and expenditures; and the common term of "service room" would have applied these measures even to a room containing only, for example, a water pump. Subsection M

The Northern Measures requirements for combustion equipment rooms are consistent with the overall principle (expressed in Subsections 34C and 34D) of a complete separation between the air supplied to and emitted from the combustion equipment, and the air supplied to and exhausted from the dwelling spaces. Towards this end, an air barrier is required in the walls, floors and ceilings separating the combustion equipment room from other areas of the dwelling. Another area of concern is access to the room, since a door left open can negate other efforts to achieve a separation. It would therefore be ideal to completely isolate this type of service room from living areas and to allow access only from the outdoors or through an unheated vestibule, but practical considerations, especially in the case of basements, have led to the option of providing access by an interior air lock. It is recommended, however, that access be provided from an exterior vestibule wherever this is possible.

The supply of combustion air to a combustion equipment room is covered in Section 34, which allows air to be supplied to the room, as long as the ambient temperature does not fall below 10°C.

The only change made to Subsection P has been to clarify terms where reference is made to cubic metres.

SECTION 6: DOORS

A(4)
Table 6A

The constructional requirement for doors with closers has been inserted to overcome the common tendency to use the same type of door for all applications.

Subsection B

The requirement for doors has been extended to include vestibules and service rooms.

Subsection C

The change in C(1) is taken from the 1985 draft NBC. C(2) requires a door wide enough for access by a disabled occupant, and is consistent with the provisions of Subsection 5A.

E(1)

RS 1980 defined exterior doors in terms of their type of construction, leaving open the question of when an exterior door is required. In view of the Northern Measures requirements for unheated vestibules and the need to have both vestibule doors satisfy criteria for external doors, it was decided to clarify this question in E(1).

Subsection E

Several provisions are intended to achieve a reduction in air leakage and an improvement in thermal performance. The base requirement for a 0.38 RSI thermal performance of exterior wood doors is modest and is easily achievable with stock units. Similarily, the RSI 1.23 requirement for metal doors is based on performance available in standard units. Requirements for weatherstripping, sloping sills, caulking and thermal breaks are all basic to good thermal performance and to trouble-free operation in the North. A performance standard is provided for air infiltration, at a level obtainable from several manufacturers. Finally, a cross-reference has been made to Subsection 28D for caulking.

Subsection F

Changes in permissible glass areas for doors are taken from the 1985 draft NBC. The Northern Measures has provided a new clause requiring a thermal resistance for glazing in doors or sidelights separating an unheated vestibule from a heated space. The level of performance required, RSI 0.29, is designed to be consistent with 7B(3) and 7B(4), which provide that glazing shall have a thermal resistance of RSI 0.45, except that an the glazing separating an unheated enclosure from the rest of the dwelling may be considered the equivalent of RSI 0.16. hence, (0.45 - 0.16) is equal to the RSI 0.29 requirement.

Subsection G

Garage door requirements have been modified to increase the height from 1.93 m to 2.44 m, to provide for the entry of 4x4 vehicles which are common in the North. Garage doors will also be required to achieve a thermal performance of RSI 0.38.

Subsection H

Changes have been made to the Hardware Subsection include a requirement for lever handles to be used on both sides of all exterior swing doors. This measure reflects the difficulty of using a knob-type handle with heavy mitts or gloves. Exterior doors, doors to combustion equipment rooms and to an attached garage will require closers, located on the warmer side of the door, in order to reduce the possibility of malfunction. Appropriate closer standards have also been referenced.

SECTION 7: WINDOWS

A provision has been added to ensure that windows or vent closures can be upgraded with storm windows and/or screens. The need for screens on openable windows or vent closures is obvious. The ability to install storm windows on all windows, even fixed ones, is required so that thermal performance can be upgraded later by the owner, and so that temporary protection can be provided if windows are broken. A(4)

The RS 1980 principle of imposing a minimum for glazed areas, to ensure adequate daylight, has been retained. The minima have, however, been reduced - for Kitchens from 10% to 5%, and for Living and Dining rooms from 10% to 8%. The change is a recognition that northern designers have for some time expressed the view that the existing minima are too high for the North. B(2)

The Measures requirement for triple glazing has been adopted, stated it in performance terms and permitting the alternative of double glazing plus a storm window. B(3)

An important change in this Section is the adoption, with modifications, of the approach taken in the NRC Measures for Energy Conservation for limiting the maximum area of glazing. The Measures uses an upper limit for glazing area of 15% of the floor area served; this has been reduced to 12% in the Northern Measures. The Northern Measures also limits the proportion of the exterior wall area that can be glazed, a measure which comes into play only with very large floor areas. B(5)

Another clause adopted from the Measures is one which recognizes the heat gain from South-facing windows. Its inclusion in the Northern Measures reflects the fact that, despite long and sunless winters in the North, Spring and Fall solar gain can be considerable. B(8)

Air infiltration standards have been set to a level whichcan be reached by several window manufacturers. B(9)

The limitation imposed on the use of non-vitreous glazing is meant to cover materials such as Lexan, which B(10) have been used to reduce the frequency of glass breakage. The use of these materials have led to a concern that occupant will face severe risks in cases of fire, since windows cannot then be broken for use as emergency exits or for the entry of firemen.

Window standards and glass standards have been revised Subsections
in accordance with the 1985 draft NBC, and a Subsection for C, D & I
skylights has been added.

SECTION 8: STAIRS, RAMPS, HANDRAILS AND GUARDS

Changes made in this Section are relatively minor. B(3), D(5)
Several clauses have been added to minimize the problems of & D(6)
snow accumulation and clearance.

The 1985 draft NBC proposes major changes to rise and Subsection C
run requirements for stairs, but it has been decided not to
accept these until back-up justification is reviewed.

Other changes result from the adoption of 1985 draft NBC proposals.

SECTION 9: MEANS OF EGRESS

The addition of the term "combustion equipment room" has B(5)
enabled exit requirements from service rooms to be made more
specific. It was also considered that the prohibition on
door opening onto exit passageways is only necessary in
buildings containing more than one dwelling unit.

Two clauses have been proposed in the 1985 draft NBC to B(9), B(10)
deal with egress and access for the physically disabled, and
they have been included here.

Many of the changes in this Section are based on the
1985 draft NBC. One exception is a clause designed to deal
with the danger of snow accumulation outside an exit door.
In this case it was decided that the disadvantage of having F(10)
a step to a landing outside an exit door was less important
than the risk of blockage because of snow accumulation.

Changes have been made in the provision of egress from I(1)
dwelling units, to maintain consistency with the measures
adopted in Subsection 5L. The RS 1980 provision for I(2)
emergency exit through upper floor windows has been made

more restrictive in recognition of the greater risk from fire in the North.

SECTION 10: FIRE PROTECTION

This Section has been substantially revised in the 1985 draft NBC, especially in Subsections D, H, I and O.

Other changes to this Section have been based on the assumption that the Northern Measures will (unlike the RS 1980) apply mainly to areas without a fire department or a mains water supply, and that greater protection is required to avoid the start and spread of fire, and to alert the occupants of danger as quickly as possible.

One clause dealing with the direction of door swings to service rooms has been removed [10M(12) in RS 1980], since it deals with non-residential occupancies.

Subsection P

Other specific changes put forward in the draft 1985 NBC inlude substantial reductions in permissible flame spread ratings. Although it is recognized that this will eliminate the use of some materials currently popular in the North (for example, factory-finished wall board), it does permit the use of common combinations such as drywall and paint.

Although the changes in alarm and detection systems originate in the proposed NBC changes, the Northern Measures has also stiffened requirements for smoke alarms, R(2) both in number and in their type and method of installation. R(4), R(5)

S(6) Finally, the Northern Measures now requires the installation of two field-rechargable fire extinguishers, a measure which is already accepted by many northern designers.

SECTION 11: SOUND CONTROL

No revisions have been proposed for this Section.

SECTION 12: EXCAVATION

Minor changes have been made to ensure the protection of permafrost during excavation, and to prevent thawing.

SECTION 13: WATERPROOFING AND DAMPPROOFING

Two minor changes have been adopted from the 1985 draft NBC proposals. The requirement for dampproofing of slabs on ground has been modified, and Type S roll roofing has been removed as a permissible material for dampproofing. A(3) F(2)

SECTION 14: DRAINAGE

Only one minor change is proposed by NBC 1985, a reference to a new standard for corrugated pipes. The Northern Measures has added two minor changes to ensure adequate surface drainage. Clause F(2) deals with areas adjacent to the building and specifies that grading shall be by fill only, so that the existing surface is not disturbed. F(3), on the other hand, allows drainage channels to be cut into the existing soil under the building, to cover the case of sites which have an existing depression which might collect water. F(2) F(3)

SECTION 15: FOOTINGS AND FOUNDATIONS

Some rearrangement has been made of paragraphs between Subsections A and B, dictated by editorial logic. In general, the Section includes measures to protect permafrost from thermal activity and to ensure that structures are not erected where permafrost activity is likely to create instability.

Since much development is occurring in this field, several clauses ensure that designers have options to explore innovative solutions which are not covered by the prescriptive clauses in the Northern Measures. A(4), B(1)

The most important principle followed is that of eliminating heat transfer to the permafrost. The Northern Measures takes the approach of permitting the use of granular pads, a ventilated foundation space, or insulation installed between the building and the ground surface, or any combination of these. Specific clause essentially flow out of this starting point. B(2)

Subsection C now includes requirements for granular pads for surface foundations in permafrost areas, including dimensions, bearing pressures and construction techniques. Requirements for stepped footings have been adopted from the 1985 draft NBC and the Northern Measures includes clauses on foundations embedded in permafrost and the use of wood sills. Subsection C

The Subsection on joist and beam supports now omits reference to termites and includes a new provision to minimize beam deflection due to permafrost movement under footings. Subsection E

Subsection G was entitled "Foundations on Permafrost" in the RS 1980. These measures have now been redistributed throughout the previous Subsections. Subsection G now deals with pile foundations, and contains a new clause to cover the use of piles in permafrost. Subsection G

SECTION 16: SLABS-ON-GROUND

The 1985 draft NBC has proposed to reduce the number of Subsections, and this format has been followed in the Northern Measures, except for one new Subsection to deal with slabs on permafrost. All changes in Subsections A, B, C and D are taken from the NBC proposals.

Specific provisions for slabs on permafrost follow the principle used in Section 15, of permitting the designer to use one or a combination of options. The most novel feature of this Subsection is the specification of requirements for sub-floor venting, one of the options which may be used. E(8)

SECTION 17: COLUMNS

No revisions have been proposed for this Section.

SECTION 18: CRAWL SPACES

In the Residential Standards, crawl spaces were taken to mean enclosed spaces under a house. The Northern Measures has extended this to include the open space under many northern houses, leading to a renaming of Subsection B.

An attempt has been made to clarify the rules for the use or omission of skirtings in a functional manner, so that their use as decorative screen to hide the house supports is limited to those areas where this can do no harm. Specifically, performance requirements for rate of ventilation have been included, and, where it is desired to use skirting, requirements have been established for removable sections to be included. B(2), B(3) and B(4) B(6)

SECTION 19

There are two main mechanisms by which moisture may be introduced into an attic space: moisture may be transported by air currents which leak from the conditioned spaces into the attic, and water vapour may diffuse through permeable materials because of differential water vapour pressures. For many years building codes have called for ventilation of attics and roof spaces so that condensation can be prevented by sweeping away water vapour that may have leaked into them by one or both of these mechanisms, and of providing a means whereby any moisture that has condensed can be dried out under milder weather conditions.

This approach is, however, akin to a doctor treating a symptom rather than the underlying disease. If a well sealed and high quality air-vapour barrier is installed, there will be no air leakage into the attic or roof space and, since vapour diffusion through an air-vapour barrier is slight, the prime mechanism for moving water vapour into the attic will have been removed.

No air-vapour barrier is perfect, however, and therefore any water vapour which has entered the attic space must be allowed to leave it. Where the onward migration of water vapour by diffusion cannot be provided for because of the vapour resistance of the roof sheathing or covering, then it must be removed either by ventilation or by draining it off the top side of the air-vapour barrier.

Clauses B(1) and B(2) contain the standard requirement for ventilation that has proved satisfactory in most cases in the South. B(1), B(2)

With flat or nearly flat roofs it is not possible to make any provision for draining water out of the roof construction and such roofs must therefore be ventilated. The 75 mm clearance provides space for air to enter at one side of the roof and leave at the other. There is no requirement for the joist or rafter spaces to be cross connected. B(3)

If the joist or rafter spaces are cross connected, then any vapour that leaks into one space can dissipate, to some B(4) extent, into the adjacent ones. In addition there is the possibility of air flow in two directions to carry the vapour away. The clearance under the cross purlin in this case can be reduced to 25 mm giving a total clearance under the roof deck of 63 mm; (25 + 38 mm), between purlins.

In attics the clearance between the insulation and the roof deck can be reduced locally near the eave provided that the required ventilation area is maintained. B(5)

With steeper roof slopes it becomes possible to slope the air-vapour barrier and to drain condensed water to the outdoors. Under these conditions the designer has a choice of providing ventilation or of filling the roof cavity with insulation and providing the necessary drainage paths. If he chooses to provide for drainage then each joist or rafter space must be blocked at the highest point to prevent wind induced flows in the insulation [See also 26 D(13)]. B(6)

In some locations very fine wind driven snow is carried into roof spaces through vents by currents of air. In such cases more moisture is added to the roof space by the ventilating air than is swept away by it. Where this situation prevails the designer has the option of sealing up the roof space in winter and providing large openings that can be used in summer to dry out any accumulated moisture. If this course is followed these summer ventilation openings must be closed tightly in winter to keep the blowing snow out. B(7)

Access hatchways from the conditioned space of the building into unheated attics frequently form a major leakage path through the air-vapour barrier. In extreme cases they may even be left open. Preferably, therefore, access should be from the outdoors. If this is not done then C(3) gives some requirements to ensure that the thermal and air tightness characteristics of the building envelope are maintained. Regardless of where it is located, the hatchway must have an airtight door or cover; to stop air leakage from the inside and to keep blowing snow out from the outdoors. With some designs it may be possible to provide access from a cold vestibule or similar unconditioned space to avoid the blowing snow problem. C(2), C(3)

SECTION 20: ABOVE-GRADE MASONRY

No revisions have been proposed for this Section.

SECTION 21: CHIMNEYS AND FLUES

Most changes made in this Section are due to proposals made in the 1985 draft NBC.

Other significant changes and additions have been made in response to the problems of flue condensation, icing-up and variable wind pressures. Specifically, the flue must be protected so that the warm, moist flue gases do not meet surfaces on which they will condense and freeze, which suggests short lengths of exposed chimney. Short chimneys may, however, exhaust at levels where wind turbulence caused by the roof may exist. The Northern Measures requirements attempt to strike a balance between these two conflicting requirements. B(9), B(10)

SECTION 22: FIREPLACES

This Section has been rewritten to be in accord with the principles established in the new Sections 33 and 34. The Section has also been shortened, since provisions for factory-built fireplaces have been moved to Section 34.

The main reason for concern about fireplaces is the highly variable rate of air utilization of a fireplace, which may span a range of about 150 or 200 L/s down to zero. In view of the relatively large impact which the fireplace combustion air system can have on the total air exchange in and out of an airtight dwelling, it is evident that great care must be taken to reduce the safety hazards which would result from the interaction of the combustion air system of a fireplace and the ventilation air system of the dwelling.

Section 22 as now written will allow a fireplace only if it conforms to stringent requirements for air supply and isolation from the living areas. Currently available fireplaces will probably fail to meet these criteria, especially in the design of fireplace doors. This undoubtedly imposes a burden on designers building in areas where firewood is cheap, and it will be argued that fireplaces have shown themselves to be safe in the past. It must be considered, however, that the use of fireplaces in B(1), B(2) relatively airtight houses is a new situation, and that the provisions of this Section are a rational response to it.

Two of the clauses are adopted from a recent CSA
Standard for Factory-built Fireplaces. The first fixes the B(3)
proportion between intake and flue areas, thereby ensuring
an adequate supply of outdoor combustion air. The second
specifies that the air intake shall have a damper, and that
it shall be interlocked with the flue damper, so that it G(2)
becomes impossible to operate the fireplace with the outdoor
air intake in the closed position.

The new requirement for installing the fireplace within B(4)
the building envelope has led to a simplification of certain
previous RS 1980 clauses, which specified the thicknesses of D(1), H(2)
fireplace walls and smoke chambers for fireplaces exposed to
the outdoors, a situation which cannot now occur.

SECTION 23: WOOD-FRAME CONSTRUCTION

Relatively few changes have been proposed for this lengthy Section.

Two clauses in the Subsection on allowable spans have Subsection D
been modified according to 1985 draft NBC proposals. Minor
modifications have been made to requirements for sill G(2)
plates, in the interests of flexibility. A major addition is
a clause specifying deep section steel or wood members for H(3)
beams supported by piers or footings on permafrost. This
measure reflects severe problems which have been encountered
in the North with differential movement of beams which are
adequate to meet superimposed loads, but lack sufficient
stiffness to reduce the effects of movement. Several other H(5) to H(8)
changes in the same Subsection are due to proposed NBC
proposals. Finally, the Northern Measures has added a H(11)
performance requirement for the prevention of overturning
and lateral distrortion of beams, again in response to
northern experience with problems in this area.

Almost all changes in subsequent clauses originate with
NBC proposals, and are minor in their impact. One exception
is the addition of 2 new Subsections, one of which permits Subsections
some scope for the use of new types of framing and another S and T
which provides for the drainage of exterior walls (See also
26D(17). addition, several clauses throughout the Section
that contain the term "sheathing paper", have been changed
in the Northern Measures to "sheathing membrane".

SECTION 24: SOLID WOOD WALL CONSTRUCTION

This Section formerly covered post, beam and plank construction, but it was felt that all solid wood wall construction should be addressed, including log houses in particular.

The log-house Subsection (G) is however blank, since a CMHC/Log Builder's Association Task Force is working to develop a nationally acceptable standard, which will be included in the Northern Measures as soon as it is reviewed and available.

The few changes which have been made in this Section have been taken from proposals made for the 1985 draft NBC, except for two clauses in which the term "sheathing paper" have been replaced by "sheathing membrane".

SECTION 25: SHEET STEEL STUD WALL FRAMING

Minor changes have been made in Subsection A, where cross-references are added. Changes proposed to the 1985 NBC have been adopted in the Subsection on installation of framing. Subsection C

SECTION 26: THERMAL INSULATION AND THE PREVENTION OF CONCEALED CONDENSATION

This section has been completely revised from the corresponding section in Residential Standards 1980. The overall objectives of the new section are to ensure that sufficient insulation is provided to result in an economic level of energy conservation and that action is taken to control air leakage, both to promote energy conservation and to ensure the durability of the building.

Clauses B(2) and B(3) provides alternative ways of determining the overall thermal resistance of the above ground portion of a building based upon life cycle costing. B(2), B(3)

As insulation is added to a building assembly, the construction cost of that assembly is increased, but the heat lost through it, and thus the energy cost, is reduced. The construction cost is a one-time capital expenditure, usually paid for by means of a mortgage, and the cost of heating is an continuing expenditure which will change, as the cost of fuel changes. These factors tend to make a comparison difficult, but the life cycle costing technique allows a valid comparison to be made, and can be used to show which level of thermal performance results in the lowest total expenditure, expressed in terms of present-day costs. The factors that must be considered are:

Temperature and time as expressed by degree days x the hours in a day	24D
An adjustment factor that relates degree days to the change in the amount of energy needed to heat the building that is caused by a change in thermal resistance of the building envelope	k
The cost of unit quantity of fuel	C
The energy content of unit quantity of fuel	F
The seasonal efficiency of the heating equipment	E
The cost of adding each increment of insulation	B
The rate of increase in the cost of fuel	e
The rate of interest on money	i
The economic life of the building	n

The last three factors can be combined to give the present worth factor (P) which is used to convert the cost of heating in future years to their equivalent present value so that they can be combined with the present day cost of constructing the building assembly. The formula used to do this is:

$$P = \frac{1 + e}{i - e}\left[1 - \frac{1 + e}{1 + i}^{n}\right]$$

Then the thermal resistance that gives the minimum combined construction and heating cost is given by:

$$RSI_{opt} = \sqrt{\frac{24\ kDCP}{EFB}}$$

The following values have been chosen for several of these factors:

$k = 0.83$
$F = 10450$ W.h/L of heating oil
$E = 70\% = 0.7$
$e = 10\% = 0.1$
$i = 13\% = 0.13$
$n = 25$ years

giving $P = 18$

and $RSI_{opt} = 0.22\sqrt{\frac{DC}{B}}$

The formula is given in clause 26B (3) and it is the responsibility of the authority having jurisdiction to select suitable values for the costs of adding insulation and the cost of heating oil in its region. The cost of heating oil must be used even though it may be intended to use an alternate fuel such as wood. This is necessary since oil is by far the most widely used fuel in the north and the building may be converted to oil heat at some future date.

The authority having jurisdiction may be a central authority that constructs buildings in many locations. In such a case, the authority may select some average values for B, C and D throughout its area, to standardize the type of construction used, or, alternatively, two or three value for different areas to standardize the types of construction.

The values in Table 26A were derived from the formula on the basis that at most locations in the North there is a rough relationship of 10 to 1 between the cost of adding insulation (B) and the cost of a litre of heating oil (C).

It will be noted that, unlike some energy conservation recommendations for the south, only one RSI value is given for the above ground portion of the building envelope. In southern construction the cost of adding insulation varies widely with the assembly that is being insulated. Large quantities of insulation can be added in attics relatively cheaply but it requires a modified type of construction to provide space for insulation in a wall. In the North, with the larger amounts of insulation that are used, it is probable that similar construction techniques will be used for floors, walls and roofs, i.e., a trussed system of some form. Thus the cost of adding insulation will be similar in all parts of the envelope and so only one RSI value is specified.

B(4) The economies of insulation applied to foundation walls below ground is not so well established as for above ground assemblies. Thus the below ground insulation value has been set for all locations as equivalent to 50 mm of extruded foamed polystyrene. Above ground, it is assumed that insulated wood construction can be used to cover the outside face of a concrete wall and so thermal resistances equal to half of those specified for above-ground building assemblies have been specified. The change over from one insulation value to the other is specified as being at 250 mm above ground to give some small margin above the 200 mm below which wood siding cannot be used (See 28 B(2)).

A special problem is presented by those concrete or masonry basement walls that have more than 50% of the face of any one wall exposed to the outside air. A reduced level of insulation on such a wall relative to the superstructure could lead to unacceptably high rates of heat loss and so the portion more than 250 mm above ground is required to be insulated as for the superstructure. Concrete and masonry should not be used for the above ground parts of such walls but rather a change should be made to timber or steel construction.

Finally, foundation walls other than those of concrete or masonry, i.e. wood or steel walls, are required to have their portions more than 250 mm above ground insulated as for the superstructure since they are really of the same type of construction. [See also D(6) and (7)].

B(5), B(6) In certain circumstances it may be desirable to deviate from the strict application of the thermal requirements of the Northern Measures. For example, in some particular types of construction it may be uneconomic to put the full amount of insulation in all assemblies, or a spectacular view may make a larger window desirable. B(5) gives the designer the option to reduce the thermal performance of some parts of the building provided that the thermal performance of other assemblies is increased to compensate. B(6), however, puts a lower limit on the thermal resistance of any above ground building assembly which means that the possible reduction in thermal resistance in milder locations is relatively small. This absolute minimum thermal resistance was considered to be essential to ensure that no assembly could be left more or less uninsulated no matter how much extra insulation was added elsewhere.

Once insulation has been built into the building envelope it is costly to add more, whereas mechanical systems can be changed relatively easily. Some devices, such as for heat recovery, are not essential for the operation of the building and could simply be switched off or not repaired if they failed. The efficiency of others may fall off because of poor maintenance. Should this happen, after the thermal performance of the building envelope had been reduced in anticipation of higher than normal performance of the mechanical system, the result would be an energy inefficient building. Such trade-offs are prohibited by B(7). B(7)

B(2) and (3) require only one R value for the whole envelope and so B(8) will be required only when attic insulation has been increased under the provisions of B(5). B(8)

Generally, it is bad practice to carry air ducts outside of the insulated envelope both because of the extra heat loss and because of potential air leakage passages at the points where the duct passes through the air barrier. It should never be necessary to do so with new buildings but may be unavoidable with the reconstruction of existing ones. Where the situation cannot be avoided the requirement that the duct be sealed against air leakage and insulated to the same level as the building envelope is a minimum requirement. Ducts carrying heated air have a greater temperature difference from the outside air than the building and so the thermal resistance must be increased proportionately. B(14)

Air leakage can be defined as the unwanted or unintended movement of air into or out of the conditioned space inside a building. In addition to increasing the energy consumption of the building and possibly causing cold draughts, such uncontrolled movement of air is frequently a prime cause of C(1), C(2) see also C(5), C(6) deterioration of the building envelope. An inward flow of cold air may cool the portions of the envelope that are inside the insulation and so cause condensation on the interior surfaces. An outward flow of air may carry considerable quantities of water vapour with it, leading to condensation within the building envelope and subsequent damage. A convective flow of air from the room into the envelope and back to the room can also deposit water in the envelope without there being a leak to the outside.

While air movement is usually the prime mechanism for moving water vapour to a point where it may condense the effects of vapour diffusion should not be ignored. Vapour diffusion takes place when there is a difference in the moisture content of the air producing a difference in vapour pressure. It should be noted that the moisture content of the air is not the same as relative humidity which for a fixed moisture content varies with temperature.

To stop the movement of air, an air barrier must be created and since large quantities of moisture can be swept through even relatively small holes this air barrier must be continuous. Similarly to stop moisture movement by diffusion a vapour barrier is needed. These two barriers should be combined in one air-vapour barrier.

Since the air barrier is the component in the building envelope that stops the passage of air it seems almost superfluous to specify that it must be strong enough to carry the wind load. However, since it is located towards the inside surface of the building envelope, (see C(8)) the fact that wind pressure can act through holes that occur in the outer skin of the envelope to press against the air barrier is often overlooked. Holes in the outer skin can occur either by chance but frequently they are provided as part of an open rain screen design, for ventilation of the cladding or for drainage. [See D(17)]. C(4)

As a separate, but related issue, it must be pointed out that while the wind pressure acting inside the thickness of the envelope is not harmful, a flow of cold outside air through the insulation destroys the effectiveness of the insulation. Such flows must be stopped by compartmentalizing the envelope especially at and near changes in direction. (See D(13))

Ducts should pass straight through the building envelope and in new construction should be restricted to intake and exhaust ducts. It is important that moist exhaust air should not be blown into the insulated envelope and that a flow of cold outside air should not be induced by a leaky intake. C(7)

When an air-vapour barrier is installed in the envelope it must be assumed that room air and humidity will come in contact with it. Thus, if condensation is not to occur on it, the air-vapour barrier must be kept above the dew point temperature of the room air. This is the underlying purpose of C(8). However just to specify it in that way could present some problems of interpretation as to what the dew point temperature might be and how to calculate the temperature gradient through the envelope. C(8)

By calculation it can be shown that when the outside temperature is -35°C and when one-quarter of the total thermal resistance of the envelope is on the warm side, or when the outside temperature is -50°C and one-fifth of the total thermal resistance is on the warm side, the air-vapour barrier will remain above the dew point temperature of the room air until the relative humidity rises above about 39% with a room temperature of 22°C. Since, with a fixed inside temperature, the temperature at any point through the envelope will vary directly in proportion with changes in the outside temperature, the proportion of the total thermal resistance that can be positioned on the warm side of the air-vapour barrier can be obtained by interpolation between these values.

If the inside temperature or relative humidity is expected to vary significantly, from 39% at 22°C, the position of the dew point temperature relative to the air-vapour barrier in the proposed construction should be checked by calculation.

There is a wide variety of metal framing members that may increase the heat loss from the building. The requirement that the thermal resistance of the heat flow path through them be increased by their being covered with at least 25% of the thermal resistance required by B(2) or B(3)is a rule of thumb taken from the Measures for Energy Conservation in New Buildings issued by the Associate C(9)

Committee on the National Building Code. There is no requirement for this extra insulation to be applied on the outside. However if it is applied on the inside and the air-vapour barrier is in contact with the framing member, as is possible under the provisions of C(8), the air-vapour barrier could be very cold at the points of contact with an attendant risk of condensation.

C(10) Subsection 34D requires that the products of combustion be prevented from being drawn into the habitable part of the building either by the use of suitably designed equipment or by the appliance being installed in a separate service room. Subsection 5M requires that an air barrier be installed between a service room and the habitable spaces and that this installation be in accordance with subsection 26C. However, 26C only refers to air-vapour barriers and so this clause has been added to ensure that all the necessary steps are taken to seal the air barrier.

D(1), D(2) and D(3) For the insulation to be effective it is essential that currents of air should be prevented from flowing through or around it. Preferably, therefore, it should be faced on all sides with an air impermiable material.In some instances, however, this may not be possible, as is usually the casewith insulation applied over a ceiling in an attic. But in all cases, the insulation must be in contact with the air-vapour barrier at least since this is the one layer that is called upon to be both air tight and continuous; all other layers could have holes in them through which air could circulate to bypass the insulation.

D(5) Loose fill insulation almost invariably settles after installation. With a horizontal or nearly horizontal surface this will cause a slight reduction in insulating value over the whole area and in many cases a thicker layer of insulation can be installed initially to allow for this. With vertical faces, such as a wall stud space, settlement will leave an uninsulated space at the top and it is not possible to provide for this during construction (see also D(12)).

D(6) Heat loss through basement walls can be a major component of the total building heat loss. It has been found that even in southern locations adding insulation on the inside of a concrete wall does not reduce the heat loss as much as might be expected unless the insulation is carried down to the level of the basement floor because the heat is conducted up the wall to be lost from the exposed face above ground. Furthermore, insulation on the inside of the wall subjects the top portion of the wall to a greater range of temperatures thus increasing the risk of cracking because of expansion and contraction and of damage on freezing. Thus it is preferable to place all of the insulation on the outside but for practical reasons this may be difficult in some cases. Carrying at least the below ground insulation on the outside from basement floor level to the top of the wall gives the wall some protection and reduces the heat lost by conduction up the wall. Wood and steel foundation walls are exempted sinced they would have insulation within their thickness as for above ground construction.

If a large proportion of a concrete or masonry wall projects out of the ground the heat lost by conduction up the wall and dissipation to the air will be greatly increased relative to the wall with only a small amount above ground. Thus if more than half of the wall is exposed to the air all of the insulaton required for the upper portion must be applied on the outside. In other cases the designer has the option of putting it on the inside. D(7)

As stated with respect to B(4) concrete or masonry should not be used for the above ground parts of such walls.

Wood and steel foundation walls are exempted since they would have insulation within their thickness as for above ground construction.

Clauses D(8) and D(9) deal with opposite conditions. D(8) relates to the condition of a building built on permafrost whose bearing strength is reduced when it thaws. In such a case, the ground must be kept frozen and insulation placed under a slab on ground, for example, to restrict the heat flow from the building into the ground. D(8), D(9)

D(9) on the other hand relates to a soil that is stable when not frozen but which will heave as it freezes. Silts and clays are examples of such frost susceptible soils whereas coarse sand and gravel are not. With one of the frost susceptible soils heat must be allowed to reach the soil to prevent it from freezing. D(9)

The vast majority of insulating materials derive their thermal resistance from the air that is trapped within them. The function of the matrix of fibres or foam is to prevent, or at least slow down, the movement of this air under the action of the convective forces that will inevitably be set up by the temperature difference between one side and the other. These forces are relatively small when compared to wind forces and fibrous or open cell foam insulating materials are quite incapable of stopping the wind from blowing through them. Closed cell foams or those that have an impervious skin applied to them will stop the wind but unless the joints are sealed perfectly the wind could still penetrate to what was meant to be the warm side of the insulation. If the joints are sealed perfectly then the insulation becomes an air barrier and must be capable of withstanding the wind load. On the other hand, if the insulation is in full contact with the air barrier (see D(1)) then there will not be a space on the warm side to allow passage of the wind and so the joints in the boards of insulation will not need to be sealed. D(13)

Fibrous insulations must be in contact with the air barrier to stop convective flow around them but even so they have so little resistance to wind induced air flows that it is essential that their outer faces be covered to stop the wind from blowing through them. In addition, this outer covering must keep rain and snow out of both the insulation and the fabric of the building envelope. Finally it must protect those materials (principally plastic) that are deteriorated by solar radiation. With all these functions to perform it should be refered to as a weather barrier.

In short a "weather barrier" can be defined as "a covering provided to keep wind-induced air flow out of the insulation and to protect the building envelope from rain, snow and ultra violet radiation".

It should also be recognized that the weather barrier is not intended to prevent the wind from blowing straight through the envelope and into the building - that is the function of the air barrier - but it is intended to prevent the sideways flow of air within the insulated envelope itself.

There are, however, other requirements that may have to be met at the same time. Despite the efforts that will have been made to make a perfect air-vapour barrier (see C(1)) one cannot be certain that perfection will be achieved. Some vapour will still diffuse out and some air leaks will occur. It is important that any moisture that moves outward from the building is not trapped in the envelope by the weather barrier. As a minimum, the weather barrier should be sufficiently pervious to vapour diffusion that at least the water vapour that diffuses through the air-vapour barrier should continue to diffuse to the outside and not condense. That this condition has been met can be determined to some extent by calculating the vapour pressure gradient through the building envelope following generally accepted procedures such as are given in Chapter 21 of the ASHRAE Handbook of Fundamentals or Canadian Building Digest No.57. Such calculations are at best approximate because of the limited amount of data about the permiability of building materials and, in addition, they take no account of air movement.

It is virtually impossible to calculate the quantity of condensation that will take place because of air movement since, in most cases, one does not know where the hole is or how big it is. Because of the long periods of cold weather in the North it is prudent to assume that considerable quantitites of water can be deposited on the inside of the weather barrier. This will probably be in the form of hoar frost or ice. As such, it is unlikely to be harmful to the fabric of the envelope until it melts when large quantities of water can be released at one time. In this event it is desirable to drain the water to the outside as quickly as possible and then to rely upon diffusion to dry out the remaining moisture. However, providing holes for drainage also provides a path for the wind to blow in.

The problem is that the designer is faced with an uncertainty as to whether his design, as constructed by the available labour force and under the conditions prevailing at the work site, will have a perfect air-vapour barrier, in which case there will be no condensed water to drain out, or whether there will be imperfections in the air-vapour barrier leading to an accummulation of water that will have to be drained out.

To reconcile the need to stop the wind from blowing through or around the insulation with that of providing drainage holes to drain water out of the envelope, the envelope must be divided into compartments so that in most of them the compartment is sealed against further movement of air within the envelope. The wind will then only pressurize the compartment and there will be no flow of air through it. If the air-vapour barrier is defective then the compartment will not be sealed against the inward movement of air and the wind will be able to blow through it and into the building. If this air flow is large the hole in the air barrier should be repaired. If it is small then the leak of air into the building will probably not be noticed. This is the situation with the outward flow of air when the wind is blowing in the opposite direction. Such an outward flow could carry large amounts of water into the envelope giving the condition when it needs to be drained out.

Lateral flow of air within the insulated cavity of the envelope can still occur even with no air flow into or out of the building because of the variation in wind pressure around the building. This can be particularly severe at changes in direction because the face on which the wind is blowing will have a positive pressure on it whereas round the corner it is probable that there will be a suction.

With ventilated attics or roof spaces there is a danger that the wind which enters through the vent will blow into the open end of the insulation. Also, because of turbulence, there is a danger that the wind will enter the top surface of the insulation near the vent. These two dangers are overcome by covering both the edges and the top surface with an air impervious material. Further away from the vent it is thought that the air flow will stay out of the insulation, making a top cover unecessary. D(14)

In the case of ventilated attics the air flow can be directed up the under side of the roof sheathing clear of the insulation by the use of suitable ventilation passages.

The vapour permeance of the weather barrier determines whether D(15) or D(16) will apply. D(15) embodies what was for many years the basic philosophy on the control of D(15), D(16) condensation in walls. That is that vapour diffusion is the main driving force that leads to condensation and if the permeance of the outer layers is much greater than that of the inner, then the small quantity of vapour that diffuses into the wall will be able to continue on to the outside. Now that air leakage is recognized as being the prime driving force, the principle of continuity of vapour diffusion is recognized as being incomplete. However since the wall is required by C(1) to have an air tight and highly impervious air-vapour barrier located near the warm side, the quantity of water vapour that penetrates into the wall should be small. Thus, if this small quantity of water can dry out by diffusion during the summer months, no serious damage should occur. Furthermore, with the added protection of an air tight outer layer, the possibility of serious air leakage is reduced and the resulting condensation should also be able to dry out.

If, on the other hand, the weather barrier is made from materials with a low permeance to water vapour, it is possible that any condensation in the wall will not be able to dry out by diffusion. In this case it becomes necessary to make provision for the water to drain out (See D(18)) and in doing so the weather barrier ceases to be air tight. Now it becomes necessary to stop the wind from blowing in at one drainage hole and out at another by dividing the wall cavity into compartments.

D(18), D(19) and D(20)

The greatest wind pressure differences that would cause a lateral flow of air in the wall occur at changes in direction and so a compartment must not continue round such a change. Divisions are needed at the junction between a wall and a roof, between a wall and an elevated first floor where the wind can blow under the building and at each change in direction of plane walls. Since the wind pressure is not uniform even over the plane wall face additional divisions are called for at each floor level and the maximum dimension for any compartment is set at 12 m, which allows each wall in all but the largest of houses to form one compartment. Naturally a greater number of divisions would give greater security.

Since there is a positive pressure on the windward face and there may be a suction in the face around a corner, the wind pressures change rapidly near a corner and there may be a suction even on the windward face near the corner. Thus additional divisions are called for near any corner with a change in direction of more than 45°.

Curved walls have no corners to give natural division points, but a change in direction of 30° around a cylindrical building gives a 10 fold drop in the wind pressure coefficient; a deviation of 15° gives a 20% drop. Thus divisions are required in a curved wall at each 15° change in direction. A minimum dimension of 1 m allows for short-radius curved walls or minor deviations from a plane wall such as bay windows. Once again, the more frequent the divisions, the greater is the security against lateral air flow in the wall.

D(21) Cold floors may be caused in some cases by wind blowing through the insulation. Thus, floors that are exposed to the outside air must be protected with a weather barrier. Since it is unlikely that dwelling air will exfiltrate through a floor to cause condensation, no special requirements have been given for vapour permeance or drainage.

E(1) Considerable quantities of heat can be lost because of air movement into and out of a building. An uncontrolled movement of air can lead to deterioration of the building (see C(1) and (2) above) and rules out the possibility of recovering some of the heat in the outgoing air. The building envelope should therefore be made air tight and ventilation air supplied in a controlled manner.

The airtightness of a building can be determined by the CGSB Fan Pressurization method and expressed as an equivalent leakage area. This is the size of opening needed to give the same air flow at the same pressure difference as takes place through all the various openings in the building envelope. The value specified as being the maximum permitted represents what can be called moderately tight construction. It is considerably larger than what has been achieved in practice in many houses. On the other hand, it is much less than occurs with what, until relatively recently, could be called normal construction practice. It is specified per square metre of envelope to allow for different sizes of building.

Air-vapour barriers are not required to conform to E(5)
CAN2-51.33-M80 "Vapour Barrier, Sheet, for Use in Building
Construction" since this would limit them to thin sheet
materials as specified in the standard. Rather they are
required to be equivalent to such vapour barriers which
allows vapour permeable materials to be coated with liquid
applied coatings to reduce their vapour permeance to the
required value.

SECTION 27: ROOFING

Only one small change has been made in this Section, in G(6)
accordance with changes proposed to the 1985 NBC.

SECTION 28: SIDING

A cross reference has been added for the spatial A(5)
separations between buildings. The introduction of the term
"weather barrier" in Section 26 required that clarification B(6)
be provided on the relationship between siding and weather
barrier - the clause inserted here is a very general
performance requirement, but this will leave the designer
with maximum flexibility. A performance requirement has D(3)
also been added for the use of caulkings, and a change E(4)
in the attachment of sidings proposed for the 1985 NBC has
been adopted. The Subsection on metal sidings has been Subsection L
totally revised in the draft 1985 NBC, and has been adopted
here.

SECTION 29: STUCCO

No revisions have been made in this Section.

SECTION 30: INTERIOR WALL AND CEILING FINISHES

No revisions have been made in this Section.

SECTION 31: FLOORING

No revisions have been made in this Section.

SECTION 32: PLUMBING FACILITIES

The large number of changes that have been made in this Section reflect the large differences in levels and types of plumbing and sanitary services in the North. Most northern houses contain water and sewage tanks within the dwelling, and the filling and emptying of tanks is done by trucked service - these unique conditions require specific solutions. Another northern concern is the serious impact that system failure can have, and the difficulty and time required to make repairs. These factors have caused the NRS to err on the side of caution in specifying plumbing systems.

The reference to domestic hot water systems being used for space heating reflects the increasing use of this type of system. The system is still in a stage of early development, and the clause is therefore expressed in very general performance terms. C(2)

A minimum pressure has been specified for water distribution systems, since field comments indicate many cases of inadequate performance. C(3)

Most of the changes in the Subsection on water supply and distribution are concentrated on the design and performance of water storage tanks. The requirements have been expressed, insofar as practicable, in performance terms, and are in accord with current good practise. C(6) to C(8)

Two additions have been made in the "Required Facilities" Subsection. The requirement for floor drains now extends to service rooms containing a water tank and provisions for hose bibs have been somewhat strengthened. D(5) D(8)

In the Subsection on sewage disposal, changes will no longer permit "other acceptable means" of waste disposal for buidings with no piped water - wastes must now be piped to the building sewer in all cases. The specification that sewage tanks shall have a capacity not less than 1.5 that of the water tank is intended to provide a safety margin against overflow of the sewage tank. Other changes for sewage holding tanks, are dealt with in a manner similar to that for water tanks - an emphasis on performance standards wherever possible. E(1) E(5) E(6)

Most of the changes in this Section are concentrated in a new Subsection, "Additional Requirements". A clause specifying vent pipe design has been added as a result of many cases of frosting up of conventional vent pipes. Clauses governing faucets and urinals have been provided to encourage the conservation of water, especially important where water and sewage may be trucked. The final clause in this Subsection is intended to prevent the serious problems which would result if leakage were to occur within the building - not only a mess, but also possible leakage of water into floor insulation and a consequent loss of thermal performance.

Subsection G

G(1)

G(2), G(3)

G(4)

SECTION 33: VENTILATION AND HEAT RECOVERY

This Section, together with Section 34, deals with one of the most difficult, and even controversial, aspects of the Standard. Moreover, it is one that could, quite literally, be vital to the occupants of a building.

Ventilation is defined in both the ASHRAE Handbook of Fundamentals and in ASHRAE Standard 62-1981 "Ventilation for Acceptable Indoor Air Quality" as "the process of supplying and removing air by natural or mechanical means to and from any space. Such air may or may not be conditioned".

Standard 62-1981 makes it clear that recirculated air can be used for part of the ventilation air supplied to a space provided it is of acceptable quality. In this section, however, since air change rates are specified all of the required air must be outdoor air.

Until recently, leaky building envelopes allowed so much air to pass through them that, under most conditions all the fresh air requirements were easily met. Now building envelopes are made much tighter in the interests of energy conservation, to reduce draughts and to prevent condensation within the envelope. Thus some form of controlled ventilation is needed.

A further, and possibly more serious problem is that ventilation equipment may be in competition for air with combustion equipment. This could lead to the products of combustion being drawn into the building instead of being vented safely to the outdoors. Thus the requirements of the ventilation system and the requirements of combustion equipment for air for combustion and dilution become inextricably entwined unless the combustion process is separated physically from the air in the habitable part of the building (See 34C and D).

Although ASHRAE Standard 62-1981 is not cited in this Standard the prudent designer should note that it requires that:

(i) "Where natural ventilation and infiltration are used, the ventilation rate shall be demonstrable"

(ii) "Where infiltration supplies all or part of the combustion air, the supply rate of combustion air must be demonstrable"

The first of these requirements is particularly relevant to the requirements of Subsection E.

Other than for simple systems serving only one dwelling unit mechanical ventilation systems should be designed by a professional designer of such systems. They are, therefore, excluded from the Northern Measures and the designer is required to meet all the provisions of Part 6 of the National Building Code. A(1), A(2) and A(3)

This clause allows for the installation of a bathroom or kitchen exhaust fan which is not intended to form a full mechanical ventilation system. In such a case a natural ventilation system must be provided. B(3)

The requirements of clause B(4) could be met in most cases by the provision of a range hood or an exhaust fan drawing air from over or near the source of the contaminants. B(4)

Air will be restricted from entering a space if it cannot displace the air that is already there. The displaced air could leave via a return air system or through a louvered vent in the door or through a space under the door, in which case allowance should be made for the possible installation of a thick carpet. B(7)

C(1) The ventilation areas given in Table 33A are as given in the National Building Code with the addition of work rooms and service rooms which have been made the same as bathrooms. The requirement that ventilation shall not be through an unheated room or space has been added to avoid the possibility of warm humid air being discharged into an area that may not be insulated and which as a result would become loaded with frost and ice.

C(2), C(3) It has been shown on many occasions that openable windows are not a satisfactory means of providing ventilation. They usually lead to cold draughts and frequently cannot be closed again because of ice formation on the jambs. Specially designed ventilation openings are considered to be a better solution in that their size and location are not restricted by the requirements of a window. There is also some scope to design the vent closure so that it will not suffer from frost problems; something that is difficult to achieve with the relatively thin sash of a window. Improved designs of windows may, however, overcome these problems in which case C(2) allows them to be used.

D(1) While a mechanical ventilation system must be designed to be able to provide ventilation air at a rate of 1.0 ach and of operating continuously it is not intended that this rate should be maintained at all times. The system must be controllable to suit the needs of the occupants and capable of being switched off when the dwelling is unoccupied.

The requirement of D(2) will, in most cases, preclude the positioning of intakes and exhausts on walls. With elevated buildings air could be drawn from the open crawl space below the floor but should be located near the centre of the building to avoid eddy or venturi effects near the edge. Since elevated buildings are used in permafrost areas, warm exhaust air should not be discharged below the floor. Exhausts and also intakes could be taken through the roof, preferably near and some distance above the highest point so as to be in a location reasonably free of turbulence no matter which way the wind may be blowing.

D(5) The discharge from a laundry dryer is inevitably humid and so may add excessive humidity to the building. In addition some laundry products such as fabric softeners may give off undesirable pollutants. To prevent the buildup of humidity or pollutants the dryer should be ducted to the outdoors.

Subsection E The requirements of Subsection E apply to both natural and mechanical ventilation systems.

E(4) Outdoor air introduced into the return air duct will remain as a separate stream for some considerable distance. If this separate stream of very cold air reaches the heating equipment it will produce local cold spots on the heat exchanger that could cause condensation of the flue gases leading to corrosion and premature failure of the heat exchanger. The outdoor air should be dispersed throughout the air stream in the duct or turbulence promoted to mix the two air streams. Extra turbulence in the air flow will cause additional resistance and so reduce the airflow. It has been suggested that sufficient mixing of the two flows will take place if they have to pass round two right angle bends in the duct before reaching the heat exchanger.

E(6) The whole purpose of providing a combustion equipment room is to separate the combustion and dilution air from the house air [See 34C(1)]. If an intake duct that passes through such a room is not airtight then this separation will not be achieved.

E(7) The purpose of insulating an exhaust duct is to prevent condensation and corrosion within it and, in extreme cases, blockage by ice.

F(1) Devices that recover heat from the exhaust air, such as air-to-air heat exchangers, are sometimes referred to as ventilation systems, since the fans that provide the flow of ventilating air are often built in as part of the equipment. Such terminology is not correct since the ventilation system must operate with or without heat recovery. The purpose of clause F(1) is to ensure that ventilation is provided even though the heat recovery device may have failed or been disconnected for any reason.

SECTION 34: HEATING, COMBUSTION EQUIPMENT AND AIR CONDITIONING

This Section has been greatly revised from the 1980 Residential Standards mainly in conformance with the layout of the proposed revisions for the 1985 edition of the National Building Code. The dual underlying objectives of the Section remain unchanged, however; First to ensure that buildings are heated adequately and secondly to achieve this in a safe manner. The first objective is achieved quite simply by specifying the inside temperature to be maintained with a given outside design temperature. The second requires that careful attention be given to the details of the installation to ensure that the products of combustion are discharged to the outdoors and that suitable clearances are maintained between the components of the system and combustible material.

Clauses B(1) to B(3) define the inside temperature conditions that the heating system must be able to maintain, give a reference as to how the design outside temperature is to be established and give guidance as to how the design calculations are to be performed. B(1), B(2) and B(3)

Some combustion equipment is designed with an airtight casing that allows the combustion and dilution air to be ducted straight from the outdoors without contact with the air in the room or space in which the equipment is located. It is considered that the use of equipment of this type is the solution to the problem of ensuring that the products of combustion cannot be drawn into the habitable parts of the building. Unfortunately there is as yet only a limited number of such appliances but more are being developed. Clause C(1) is, therefore, given priority as being the way to go for the future. Clause C(2) recognizes that at present it is probable that conventional equipment that draws its air supply from the room within which it is located will have to be used in most cases. Such equipment must be located in a combustion equipment room [See D(1)] and the required resistance to the back drafting of the gases is provided by the walls, ceiling and floor of that room (See Subsection 5M). C(1), C(2)

Most combustion equipment does not function well at low temperatures. Oil does not atomize satisfactorily, for example, leading to incomplete combustion. Similarly cold dilution air leads to a cold chimney with a loss of draft and possible condensation problems. Dilution air should never be ducted straight from the outdoors. C(3), C(4)

Clause D(1) states the basic safety requirements that the products of combustion must never be drawn into the habitable spaces in the building. It gives the designer the option either of using suitable equipment that is designed and constructed from air intake to flue gas discharge to provide this separation or of separating the appliance from the rest of the building by a specially designed enclosure. The design and construction of such an enclosure will require special care to make the separation airtight. Furnace rooms as constructed conventionally in the south will not meet these requirements. D(1)

Subsections E to I are largely a reordering, in accordance with the proposed revisions for the 1985 National Building Code, of the existing requirements. Subsections E to I

Combustion appliances that burns solid fuel can constitute a safety hazard just as much as can oil or gas fired appliances. Hence they must meet the same requirements for the separation of combustion and dilution air from the room air. Unfortunately, they have two additional difficulties in doing so. First, because they require manual reloading heat by radiation as well as convection, the majority of such appliances must be installed in the habitable spaces and so cannot be located in a separate combustion equipment room. Secondly, the draft produced by an operating solid-fuel stove can vary greatly - from over 150 L/s down to nothing. A roaring fire produces a strong draft that could backdraft other equipment, but as the fire burns down the draft is reduced, eventually becoming zero when it goes out. Meanwhile, the flue must remain open while the fire is dying out, and it could then be backdrafted by ventilation exhaust fans, pulling combustion gases back into the dwelling. In the interests of safety, therefore, it is clear that these appliances must have combustion chambers L(1), L(2) which remain completely closed except at the time of refuelling. Combination stoves, that can be operated with the front open as an open fire, will therefore not be permissible under Subsection L.

SECTION 35: ELECTRICAL FACILITIES

A(2) The 1985 draft NBC has updated the reference to the CSA Code to the current 1982 edition.

A(5) A clause has been added to ensure that service panels have adequate capacity for modern requirements.

A(6), A(7) Clauses A(6) and A(7) are intended to protect the integrity of the air-vapour barrier. This is a very important part of the Northern Measures, since most projections of performance are based on the assumption that the air-vapour barrier is intact, and since punctures and tears are a very common consequence of electrical work. It is strongly suggested that the best way of avoiding the problem is to keep wiring out of the building envelope; if this is impossible, then the use of poly pans will reduce the possibility of problems.

A(8) Although the CSA Code is referenced in A(2), it was decided to add A(8) to draw attention to a specific new clause in the 1982 CSA Code dealing with wiring in insulated walls.

A(9) Clause A(9) is aimed at ensuring that penetrations of the building envelope are sealed, and that deterioration is not caused by incompatible materials.

A(11) This clause is intended to reduce the possibility of overheating of service panels which could occur in an insulated space.

A(13) The requirements for ground fault interruptors are covered in the CSA Standard, which is a required reference in this Section, but a specific reference has been added here to improve the chances of adherence.

The scope of B(2) has been expanded. The term "service B(2)
room" now includes both utility rooms and combustion
equipment rooms.

Requirements for receptacles have been augmented. C(1), C(3)
"Service rooms" has replaced "utility rooms" in C(1), and C(4), C(6)
the requirement for two duplex receptacles in kitchens has
been increased to two split duplex receptacles. In C(4), a
duplex receptacle is now also required in work rooms and in
service rooms. C(6) extends the requirement for special
purpose outlets from electric ranges to clothes dryers.

A duplex receptacle is now required for the parking C(8)
space of each dwelling unit. it is anticipated that the
added requirement for an interior switch will result in
considerable energy savings, since block heaters will now be
less likely to remain switched on for 24 hours per day.

Finally, a cross-reference has been provided to Section D(2)
10 for alarm wiring.

SECTION 36: GARAGES

No changes have been proposed for this Section.

SECTION 37: ELEVATORS

No changes have been proposed for this Section.

SECTION 38: PAINTING

Few changes have been made in this Section. A new clause A(5)
has been added to ensure that wood surfaces are dry enough
to provide adhesion for paint. Clause B(1) has been modified B(1)
to clarify the point that staining is an acceptable
alternative to painting. Finally, a new clause will ensure B(3)
that moisture which emanates from areas behind siding will
be able to escape through the paint surface.

SECTION 39: WALKWAYS, DRIVEWAYS AND PARKING AREAS

C(9)

Only one clause has been modified in this Section, to provide a wider choice in the construction of walkways.

SECTION 40: SITE IMPROVEMENT

This Section has been extensively modified, mainly through rearrangement and amplification.

A(2), A(3)

A(2) and A(3) attempt to ensure that a survey and analysis of the site takes place before construction, and to enable some degree of control over site development in order to avoid damage to the relatively fragile sites of the North.

A(4), A(6)

A(5)

A(4) and A(6) are intended to protect the environment by protection and reutilization of natural drainage patterns, vegetative cover and scarce fertile soil. A(5) deals with siting, to protect buildings from the effects of wind, flood and excessive snow accummulations. The clause is written in general performance terms, in view of the widely varying conditions in the North.

Subsection B

B(1), B(2)

B(3) to B(7)

All of the clauses of Subsection B have been amplified in order to meet special northern conditions. B(1) and B(2) are stated in very general terms, but offer leverage to prevent unnecessary damage. B(3) to B(7) are clauses from RS 1980 which have been modified.

Subsection C

Subsection C has been considerably enlarged to ensure proper treatment of grading and topsoil, both of which are of crucial importance in northern sites.

D(4)

D(5)

Two new clauses have been added to Subsection D. D(4) requires protection of erodable slopes where grass cannot be used, by specifying the use of rip-rap or the creation of conditions favourable to re-vegetation. D(5) extends this by specifying conditions which will facilitate re-vegetation.

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Measures for Energy-Efficient Northern Housing

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MEASURES FOR
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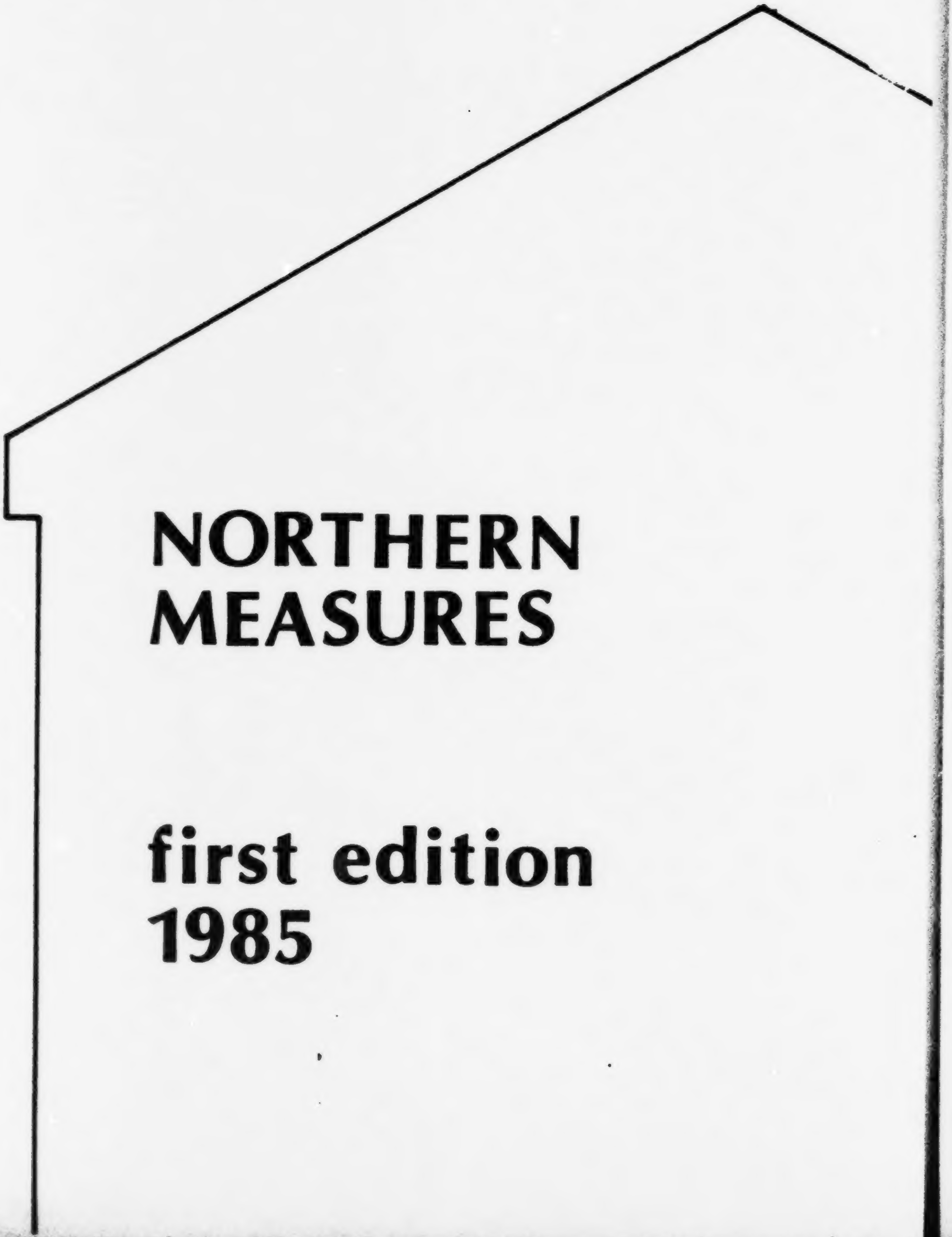

NORTHERN MEASURES

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MEASURES FOR
ENERGY-EFFICIENT
NORTHERN HOUSING

FIRST EDITION
ENERGY, MINES AND RESOURCES CANADA
1985

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NOTE

THIS DOCUMENT IS ISSUED AS A DRAFT ONLY.

An intergovernmental Advisory Committee, under the general direction of Energy, Mines and Resources, proposes to carry out a process of review of "Northern Measures" (Draft 6) during 1985 and 1986, leading to the publication of a revised document which may then be adopted by authorities having jurisdiction. Your written comments on the content and structure of the draft document are invited by April 1986, and will receive careful attention during the review period.

The members of the Technical Committee and Technical Subcommittee who contributed to the preparation of this document have acted in their individual capacities, and the draft standard should not be taken as necessarily expressing the point of view of any of the organizations represented by these individuals.

The use in this document of draft clauses proposed for inclusion in the 1985 National Building Code does not imply approval by the Associate Committee on the National Building Code.

To convey your comments or to obtain further information or additional copies of this document (in English or French), please write to:

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INTRODUCTION

Background

The Measures for Energy Efficient Northern Housing (or Northern Measures) contains draft energy-oriented building requirements intended to be suitable for residential construction in the North, including the Northwest Territories, the Yukon and those portions of provinces which experience permafrost. The Northern Measures has been prepared by an intergovernmental and interdepartmental committee under the general direction of Energy, Mines and Resources.

The broad terms of reference for the task of preparing the Northern Measures were established by the Federal Government, through the Treasury Board. The relevant Treasury Board instructions stated that a standard was to be produced in time for the 1984 building season, and that the Federal Government would thereafter require that all residential buildings falling within its jurisdiction would be constructed according to the standard.

The Department of Energy Mines and Resources was assigned the lead role in the task, and EMR consequently established the Northern Residential Standards Committee in 1982. EMR solicited the active participation of Territorial and provincial governments on the Committee, as well as those Federal Departments with a major interest in the North. Considerable emphasis was also placed on obtaining the involvement of private-sector designers, builders and organizations. The result has been a three-level structure, including an Advisory Committee, a Technical Committee and a small working Technical Subcommittee. The head of the Secretariat for the project was an EMR official located in Yellowknife, and he was provided with support by a consultant technical advisor in Ottawa.

The goal of the project was to produce a residential construction standard which would result in significant energy savings in new housing built in the North. An initial decision led to the broadening of this mandate to cover a broad range of construction problems unique to the North, including energy efficiency, on the basis that it is not sensible to increase energy efficiency if other factors lead to the rapid deterioration of the building fabric.

As the project evolved, it also became apparent that it would be premature to designate these proposed requirements as a standard. This led to the use of the word "measures" and a decision to distribute the document for comment by design professionals during a 2-year review period. The current document is therefore not intended to be used directly, but should rather serve as a discussion document to generate comment, which in turn may lead to a standard in 2 years time.

Structure of the Northern Measures

It was decided to base the Northern Measures as closely as possible on the 1980 Residential Standards, a CMHC document with which most Canadian designers and builders are very familiar. Another major element in the new Measures is the inclusion of almost all of the changes which have been proposed for Part 9 of the 1985 National Building Code In summary, the Northern Measures contain much that is new, especially in Sections 5, 15, 16, 19, 26, 32, 33, 34 and 40, while many other Sections contain at least a few changes.

The Commentaries to the Northern Measures are intended to explain the intent behind certain clauses, and do not form an official part of the Northern Measures.

UNITS

ach	air changes per hour, based on the net finished volume of the dwelling. In other words, if the net finished volume of the dwelling is 300 cubic metres, an ach of 1.5 indicates that 450 cubic metres of outdoor air is entering the dwelling in one hour.
ASWG	American Standard Wire Gauge
B&SG	Brown and Sharpe Gauge
CLS	Canadian Lumber Standard
cm	centimetre(s)
db	decibel(s)
°	degree(s)
°C	degree(s) Celsius
diam.	diameter
g	gram(s)
ga	gauge
GSG	Galvanized Sheet Gauge
h	hour(s)
Hz	hertz
in.	inch(es)
Inc.	Incorporated
J	joules
kg	kilogram(s)
kN	kilonewton(s)
kPa	kilopascal(s)
kW	kilowatt(s)
L	litre(s)
lx	lux
m	metre(s)
max.	maximum
min.	minimum
min	minute(s)
MJ	megajoule(s)
mm	millimetre(s)
MPa	megapascal(s)
MSG	Manufacturers' Standard Gauge
N	newton(s)
N/A	not applicable
ng	nanogram(s)
No.	number(s)
nom.	nominal
o.c.	on centre
RSI	the international unit for measurement of thermal resistance, measured in m^2.C/W. To convert from the imperial thermal resistance value, multiply by 0.176, e.g R20 = RSI 3.52.
s	second(s)
SWG	Standard Wire Gauge
temp.	temperature
T&G	toungue and groove
USSG	United States Standard Gauge
W	watt(s)
wt.	weight

LEGEND

All clauses that have been altered from the original RS 1980 document have been marked with a solid line beside it as indicated.

NBC

All clauses that have been adopted unchanged from the draft proposed 1985 National Building Code, as approved in draft form by the ACNBC in July 1984 are shown as indicated.

ABBREVIATIONS

ACI	American Concrete Institute
ACNBC	Associate Committee on the National Building Code
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration and Air-Conditioning Engineers
ASTM	American Society for Testing and Materials
CAN	National Standard of Canada designation Standards Council of Canada, 350 Sparks Street, Ottawa, Ontario, K1R 7S8 The number following the CAN designation indicates the agency under whose auspices the standard has been issued CAN 1 designates CGA CAN 2 designates CGSB CAN 3 designates CSA CAN 4 designates ULC
CGA	Canadian Gas Association
CGSB	Canadian General Standards Board
CSA	Canadian Standards Association
HI	Hydronics Institute (heating)
HRA	Heating, Refrigeration and Air-Conditioning Institute of Canada
NBC	National Building Code of Canada
NFPA	National Fire Protection Association
NLGA	National Lumber Grades Authority
ULC	Underwriter Laboratories of Canada
WCLIB	West Coast Lumber Inspection Bureau
WWPA	Western Wood Products Association

NOTE

Refer to the National Building Code of Canada, 1985 edition, for dates of standards referenced in this document.

SECTION 1: GENERAL

A. GENERAL

(1) This Standard applies to buildings classified as residential occupancy which, unless otherwise indicated herein, are 3 storeys or less in building height, and have a building area not exceeding 600 m^2. (The following Sections of this Standard apply to all buildings of residential occupancy, regardless of size: Nos. 2, 5 to 8, 11, 13, 14, 18, 19, 22, 26 to 33, 35, and 37 to 40.) Where a building contains a mixed occupancy, the requirements of the National Building Code of Canada (NBC) shall apply. This Standard applies both to site-assembled and factory-made buildings. (Children's custodial homes and convalescent homes for ambulatory occupants living as a single housekeeping unit, in a dwelling unit with sleeping accommodation for not more than 10 persons, may also be classified as residential occupancy (Group C).)

(2) Measures to ensure the safety of the public during construction shall conform to the appropriate requirements in Part 8 of the NBC.

(3) Buildings other than those described in Sentence (1) are regulated by the appropriate provisions contained in the NBC.

(4) Where a building or a component of a building is assembled off the building site in such a way that it cannot be inspected on site, approved off-site inspection shall be provided when required by the authority having jurisdiction to ensure compliance with this Standard.

(5) Workmanship of a standard equal to good building practice shall be provided.

(6) Every building shall provide barrier-free access in conformance with Section 3.7 of the NBC in addition to the, requirements of this Standard, except that such access need not be provided for apartment buildings without elevators or for houses, including semi-detached, duplexes, triplexes, townhouses, boarding houses and rowhouses.

NBC

(7) The designer of the building shall prepare a concise description of the operation of the building as a whole and the method of operating each system, including ventilating, heating, air conditioning, water supply and sewage disposal systems. The documentation is to be bound in a folder, together with instructions provided by the manufacturer of each item of fixed mechanical equipment installed in the building. One copy of the manual is to be given to the owner of the building upon the completion of construction.

SECTION 2. DEFINITIONS

A. GENERAL

In this Standard:

Acceptable means acceptable to the authority having jurisdiction.

Accepted means accepted by the authority having jurisdiction.

Active layer means the top layer of ground above permafrost that thaws each summer and refreezes each fall.

Air barrier means a layer in a building assembly that prevents the movement of air, but does not necessarily prevent the flow of water vapour under the action of a vapour pressure differential. (See also Air-Vapour Barrier)

Air-Vapour Barrier means a layer in the building assembly that prevents the movement of air and that restricts the flow of water vapour under the action of a vapour pressure differential to a location where it may condense.

Appliance means a device to convert fuel energy into heat, and includes all components, controls, wiring and piping required to be part of the device.

Authority having jurisdiction means the governmental body responsible for the enforcement of any part of these Measures, or the official or agency designated by that body to exercise such a function.

Bachelor dwelling unit means a dwelling unit for 1 or 2 adults with or without 1 bedroom.

Basement means a storey or storeys of a building located below the first storey.

Building means any structure used or intended for supporting or sheltering any use or occupancy.

Building area means the greatest horizontal area of a building above grade within the outside surface of exterior walls, or within the outside surface of exterior walls and the centre line of firewalls.

Building envelope means the combination of building assemblies that separates the heated spaces of a building from unheated spaces, the outdoors or the ground.

Building height (in storeys) means the number of storeys contained between the roof and the floor of the first storey.

Chimney means a primarily vertical shaft enclosing at least one flue for conducting flue gases to the outdoors.

Chimney flue means a flue that is located within a chimney.

Cladding, exterior means those components of a building which are exposed the the outdoor environment and are intended to provide protection against wind, water or vapour.

Closure means a device or assembly for closing an opening through a fire separation, such as a door, a shutter, wired glass or glass block, and includes all components such as hardware, closing devices, frames and anchors.

Combustible, as applying to an elementary building material, means that such material fails to conform to CAN4-S114-78, "Standard Method of Test for Determination of Non-Combustibility in Building Materials".

Combustible construction means that type of construction that does not meet the requirements for non-combustible construction.

Combustion equipment room means a service room that contains fuel-fired appliances or equipment intended for space heating or domestic hot water heating, or that contains an incinerator.

Crawl space means a space less than 1.8 m high between the lowest floor of the building and the ground beneath.

Dead load means the weight of all permanent structural and nonstructural components of a building.

Dwelling unit means a suite operated as a housekeeping unit, used or intended to be used as a domicile by 1 or more persons and usually containing cooking, eating, living, sleeping and sanitary facilities.

Exit means that part of a means of egress that leads from the floor area it serves, including any doorway leading directly from a floor area, to a public thoroughfare or to an acceptable open space.

Exit, access to means that part of a means of egress within a floor area that provides access to an exit serving the floor area.

Exit, horizontal means that type of exit connecting 2 floor areas at substantially the same level by means of a doorway, vestibule, bridge or balcony, such floor areas being located either in different buildings or located in the same building and fully separated from each other by a firewall.

Exposing building face means that part of the exterior wall of a building which faces one direction and is located between ground level and the ceiling of its top storey, or where a building is divided into fire compartments, the exterior wall of a fire compartment which faces one direction.

Fire compartment means an enclosed space in a building that is separated from all other parts of the building by enclosing construction providing a fire separation having a required fire-resistance rating.

Fire-protection rating means the time in hours or fraction thereof that a closure will withstand the passage of flame when exposed to fire under specified conditions of test and performance criteria or as otherwise prescribed in this Standard.

Fire-resistance rating means the time in hours or fraction thereof that a material or assembly of materials will withstand the passage of flame and the transmission of heat when exposed to fire under specified conditions of test and performance criteria, or as determined by extension or interpretation of information derived therefrom as prescribed in this Standard.

Fire separation means a construction assembly that acts as a barrier against the spread of fire and may not be required to have a fire-resistance rating or a fire-protection rating.

Fire stop means a draft-tight barrier within or between construction assemblies that acts to retard the passage of smoke and flame.

Fire stop flap means a device intended for use in horizontal assemblies required to have a fire-resistance rating and incorporating protective ceiling membranes, which operates to close off a duct opening through the membrane in the event of a fire.

Firewall means a type of fire separation of noncombustible construction which subdivides a building or separates adjoining buildings to resist the spread of fire and which has a fire-resistance rating as prescribed in this Standard and has structural stability to remain intact under fire conditions for the required fire-rated time.

Flame-spread rating means an index or classification indicating the extent of spread-of-flame on the surface of a material or an assembly of materials as determined in a standard fire test as prescribed in this Standard.

Floor area means the space on any storey of a building between exterior walls and required firewalls, including the space occupied by interior walls or partitions, but not including exits and vertical service spaces that pierce the storey.

Flue pipe means the pipe connecting the flue collar of an appliance to a chimney.

Garage, storage means a building or part thereof intended for the storage or parking of motor vehicles and which contains no provision for the repair or servicing of such vehicles.

Gas vent means that portion of a venting system designed to convey vent gases from the vent connector of a gas-fired appliance, or directly from the appliance when a vent connector is not used, to the outdoors.

Grade (as applying to the determination of building height) means the lowest of the average levels of finished ground adjoining each exterior wall of a building, except that localized depressions such as for vehicle or pedestrian entrances need not be considered in the determination of average levels of finished ground. (See Storey, first). For buildings on raised foundations, the lowest of the average levels of finished ground under the line of each exterior wall of a building, shall apply.

Guard means a protective barrier around openings in floors or at the open sides of stairs, landings, balconies, mezzanines, galleries, raised walkways, or other locations to prevent accidental falls from one level to another. Such barrier may or may not have openings through it.

Heated space means any space within a building that is intended to be heated either directly or indirectly by a heating system.

Heavy timber construction means that type of combustible construction in which a degree of fire safety is attained by placing limitations on the sizes of wood structural members and on thickness and composition of wood floors and roofs, by avoidance of concealed spaces under floors and roofs.

Horizontal service space means a space such as an attic, duct, ceiling, roof or crawl space oriented essentially in a horizontal plane, concealed and generally inaccessible, through which building service facilities such as pipes, ducts and wiring may pass.

Limiting distance means the distance from an exposing building face to a property line, the centre line of a street, lane, public thoroughfare or an imaginary line between 2 buildings on the same property, measured at right angles to the exposing building face.

Live load means the load other than dead load to be assumed in the design of the structural members of a building. It includes loads resulting from snow, rain, wind, earthquake and those due to occupancy.

Loadbearing (as applying to a building element) means subjected to or designed to carry loads in addition to its own dead load, excepting a wall element subjected only to wind or earthquake loads in addition to its own dead load.

Means of egress means a continuous path of travel provided by a doorway, hallway, corridor, exterior passageway, balcony, lobby, stair, ramp or other egress facility or combination thereof, for the escape of persons from any point in a building, floor area, room or contained open space to a public thoroughfare or other acceptable open space. (Means of egress includes exits and access to exits.)

Moisture barrier means any material which is used to retard the passage of or flow of vapour or moisture into construction and thus preventing condensation

Noncombustible (as applying to an elementary building material) means that such material conforms to CAN4-S114-78. "Standard Method of Test for Determination of Non-Combustibility in Building Materials."

Noncombustible construction means that type of construction in which a degree of fire safety is attained by the use of noncombustible materials for structural members and other building assemblies.

Occupancy means the use or intended use of a building or part therof for the shelter or support of persons, animals or property.

Occupancy, major means the principal occupancy for which a building or part thereof is used or intended to be used, and shall be deemed to include the subsidiary occupancies which are an integral part of the principal occupancy.

Occupant load means the number of persons for which a building or part thereof is designed.

Partition means an interior wall, 1 storey or part-storey in height, that is not loadbearing.

Permafrost means the thermal condition in soil or rock of temperatures below 0°C persisting over at least two consecutive winters and the intervening summer; moisture in the form of water and ground ice may or may not be present. Earth materials in this thermal condition may be described as perennially frozen, irrespective of their water and ice content.

Public building means a building to which the public is admitted, but does not include apartment buildings, houses or boarding houses.

Public corridor means a corridor that provides access to exit from more than 1 suite.

Residential occupancy means the occupancy or use of a building of part thereof by persons for whom sleeping accommodations is provided but who are not harboured or detained to receive medical care or treatment or are not involuntarily detained.

Service room means a room or space specifically provided in a building to accommodate building or dwelling service equipment such as air-conditioning or heating appliances, electrical services, pumps and compressors, incinerators or laundry facilities. (See also Combustion equipment room and Utility room).

Service space means space provided in a building to facilitate or conceal the installation of building service facilities such as chutes, ducts pipes, shafts or wires.

Service water heater means a device for heating water for plumbing services.

Smoke alarm means a combined smoke detector and audible alarm device designed to sound an alarm within the room or suite in which it is located upon the detection of smoke within that room or suite.

Sprinklered (as applying to a building or part thereof) means that the building or part thereof is equipped with a system of automatic sprinklers.

Storey, first means the uppermost storey having its floor level not more than 2m above grade.

Suite means a single room or series of rooms of complementary use, operated under a single tenancy, and includes dwelling units, individual guest rooms in motels, hotels, boarding houses, rooming houses and dormitories as well as individual stores and individual or complementary rooms for business and personal service occupancies. (See Appendix.)

Unprotected opening (as applying to exposing building face) means a doorway, window or opening other than one equipped with a closure having the required fire-protection rating, or any part of a wall forming part of the exposing building face that has a fire-resistance rating less than required for the exposing building face.

Utility room means a service room that does not contain fuel fired appliances or equipment.

Vapour Barrier means a layer in a building assembly that restricts the flow of water vapour under the action of a vapour pressure differential, to a location where it may condense (See also Air-Vapour Barrier).

Vent closure means a device or assembly for closing a ventilation opening to the outside through the building envelope.

Vestibule means a space that serves as a chamber or hall between the entrance door and the interior door of a building to which it gives admittance.

Wall, party means a wall jointly owned and jointly used by 2 parties under easement agreement or by right in law and erected at or upon a line separating 2 parcels of land each of which is, or is capable of being, a separated real-estate entity.

Weather barrier means a layer in the building envelope provided to keep wind-induced air flow out of insulation materials, and to protect all components of the building envelope from rain and snow.

B. OTHER DEFINITIONS

For words not defined in Subsection A, the definitions in Part 1 of the National Building Code of Canada shall apply.

SECTION 3. MATERIALS, SYSTEMS AND EQUIPMENT

A. GENERAL

(1) Materials, systems and equipment shall possess the essential properties to perform their intended functions.

(2) When required by the authority having jurisdiction, materials, systems or equipment shall be tested to determine the suitability for the intended use.

(3) Except as provided in (5), the test method used to determine the suitability of materials, systems or equipment shall be one that is published by a recognized agency.

(4) Materials, systems and equipment not specifically described herein, or which vary from the specific requirements in this Standard, or for which no recognized test procedure has been established, may be used if it can be shown that the material, system or equipment is suitable on the basis of past performance, or good engineering practice or on the basis of tests described in A(5).

(5) Where no published test method exists, the test shall be designed to simulate or exceed anticipated service conditions or shall be designed to compare the performance of the material, system or equipment with similar material, system or equipment that is known to be acceptable.

(6) Every test shall be carried out by an acceptable testing laboratory.

B. CONCRETE

(1) NBC Concrete shall be designed, mixed, placed, cured and tested in accordance with CAN3-A438, "Concrete Construction for Housing and Small Buildings".

(2) Cement shall meet the requirements of CAN3-A5, "Portland Cements." Sulphate-resisting cement shall be used for concrete in contact with sulphate soil deleterious to normal cement. Such concrete shall conform to the requirements in Section 16 of CAN3-A23.1, "Concrete Materials and Methods of Concrete Construction."

(3) Aggregates shall consist of sand, gravel, crushed rock, crushed air-cooled blast furnace slag, expanded shale or expanded clay, conforming to CAN3-A23.1, "Concrete Material and Methods of Concrete Construction." Aggregate shall be clean, well-graded and free of injurious amounts of organic and other deleterious material.

(4) Water shall be clean and free of injurious amounts of oil, organic matter, sediment or any other deleterious material.

(5) NBC Unless otherwise specifically required elsewhere in this Standard, the compressive strength of unreinforced concrete shall be not less than 15 MPa after 28 days.

(6) NBC When concrete is used for garage and carport floors and exterior steps, it shall have a minimum compressive strength of 20 MPa after 28 days and shall have air entrainment of 5 to 8 per cent.

(7) The concrete mixes described in Table 3A shall be considered acceptable if the slump does not exceed 100 mm when measured according to the slump test described in CAN3-A23.1, "Methods of Test for Concrete," Aggregate shall not exceed 50 mm in size.

NBC

TABLE 3A. CONCRETE MIXES BY VOLUME

Concrete Strength MPa	Cement, part	Sand, parts	Coarse Aggregate, Parts
15	1	2	4
	1	-	6, pit run gravel
20	1	1 3/4	3, up to 40 mm in size
	1	-	4 3/4, pit run gravel

(8) NBC Admixtures shall conform to CAN3-A266.1, "Air-Entraining Admixtures for Concrete" or CAN3-A266.2, "Chemical Admixtures for Concrete", as applicable.

(9) Reinforced concrete shall be designed to conform to the requirements of Part 4 of the NBC.

(10) When the air temperature is below 5°C, concrete shall be kept at a temperature of not less than 10°C or more than 25°C while being mixed and placed, and maintained at a temperature of not less than 10°C for 72 h after placing. No frozen material or ice shall be used in the mix.

C. LUMBER AND WOOD PRODUCTS

(1) Lumber for joists, rafters, trusses and beams and for the uses listed in Table 3B shall be identified by a grade stamp to indicate its grade as determined by the NLGA Grading Rules for Canadian Lumber. (See Appendix A, NBC)

(2) Except for joists, rafters, trusses and beams, visually graded lumber shall conform to the grades in Table 3B. (See 23D(1) for joists, rafters and beams and 23M(14) for trusses).

(3) Machine stress rated lumber shall conform to the requirements of Section 4.3 of the NBC.

(4) Waferboard and plywood used for roof sheathing, wall sheathing and subflooring shall be legibly identified on the face of the material indicating the manufacturer of the material, the standard to which it is produced and that the material is of exterior type.

(5) Moisture content of lumber shall be not greater than 19 per cent at the time of installation.

(6) Lumber dimensions referred to in this Standard are actual dimensions determined in conformance with CSA 0141, "Softwood Lumber."

(7) The thickness specified in this Standard for plywood, hardboard, particleboard and waferboard shall be subject to the tolerances permitted in the standards referenced for these products, unless otherwise specifically indicated herein.

(8) Joist, rafter, lintel and beam members up to 5 per cent less than the actual Canadian standard sizes may be used provided the allowable spans for the grade and species of lumber under consideration are reduced 5 per cent from those shown in the span table for full size members.

TABLE 3B - MINIMUM LUMBER GRADES FOR SPECIFIC END USES

Use	BOARDS (1)			FRAMING
	Paragraph in the NLGA grading rules under which boards are graded			All species
	All species		Eastern White Pine & Red Pine	
	Para 113	Para 114	Para 118	
Stud wall framing (loadbearing members)	--	--	--	Standard Stud.No2
Stud wall framing (non-loadbearing members)	--	--	--	Stud, Utility, No.3
Plank frame construction (loadbearing members)	No. 3 Common	--	No. 3 Common	No.2
Plank frame construction (non-loadbearing members)	No. 5 Common	--	No.5 Common	Economy, No.3
Posts and beams less than 114 mm in thickness	--	--	--	Standard No.2
Posts and beams at least 114 mm in thickness	--	--	--	Standard
Roof Sheathing	No. 3 Common	Standard	No. 4 Common	--
Subflooring	No. 3 Common	Standard	No.3 Common	--
Wall Sheathing when required as a nailing base	No. 4 Common	Utility	No.4	--
Wall sheathing not required as a nailing base	No. 5 Common	Economy	No.5	--

NOTE (1): See Appendix A, NBC

(9) Where wood is pressure treated to resist decay, such treatment shall be in accordance with the requirements of one of the following standards:

NBC

CSA 080.1, "Preservative Treatment of All Timber Products by Pressure Processes,"

CSA 080.2, "Preservative Treatment of Lumber, Timber, Bridge Ties and Mine Ties by Pressure Processes."

CSA 080.3, "Preservative Treatment of Piles by Pressure Process.

NBC

CSA 080.9, "Preservative Treatment of Plywood by Pressure Processes," or

CSA 080.15, "Preservative Treatment of Wood for Building Foundation Systems, Basements and Crawl Spaces by Pressure Processes."

CAN3 S406, "Construction of Preserved Wood Foundations."

D. METAL

(1) Minimum thicknesses for sheet metal material given in this Standard refer to the actual minimum thicknesses measured at any point of the material, and in the case of galvanized steel, includes the thickness of the coating unless otherwise indicated.

(2) Where galvanized sheet metal is intended for use in locations exposed to the weather or as a flashing material, it shall have a zinc coating at least equal to the G90 coating designation in ASTM A525, "Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements."

SECTION 4. STRUCTURAL REQUIREMENTS

A. GENERAL

(1) NBC Except as provided in (2) and in Subsections B to D, structural members and their connections shall be designed in conformance with Part 4 of the NBC.

(2) NBC Where structural members and their connections conform to the requirements listed elsewhere in this Section, it shall be deemed that the structural design requirements have been met.

(3) Areas for special uses, including those for holding and storage tanks, shall be designed to carry the loads due to their intended use.

B. SNOW LOADS

(1) NBC This Subsection applies to wood frame assemblies with clear spans not exceeding 12.20 m and members spaced not more than 600 mm apart.

(2) NBC Except as provided in (3) and (4), design snow loads shall be not less than 60 per cent of the appropriate ground snow load listed in Chapter 1 of the Supplement to the NBC, but in no case shall the design snow load be less than 1 kN/m^2 of horizontal roof projection.

(3) NBC Where the entire width of a roof does not exceed 4.3 m, the design snow load shall not be less than 50 per cent of the appropriate ground snow load listed in in Chapter 1 of the Supplement to the NBC, but in no case shall the design snow load be less than 1 kN/m^2 of horizontal roof projection.

(4) NBC Bow string, arch or semi-circular roof trusses having an unsupported span greater than 6 m shall be designed in conformance with the snow load requirements in Section 4.1 of the NBC.

(5) NBC Residential balconies not used as passageways shall be designed to carry the design roof snow load or 1.9 kN/m^2, whichever is greater.

C. DEFLECTIONS

The maximum deflection of structural members shall conform to Table 4A. Dead loads need not be considered in computing such deflections.

TABLE 4A - MAXIMUM DEFLECTIONS

Structural Members	Type of Ceiling Supported	Maximum Allowable Deflection Expressed as a Ratio of the Clear Span
Roof rafters, roof joists, roof beams and roof decking of plank and beam construction	No ceiling	1/180
	Other than plaster or gypsum board	1/240
	Plaster or gypsum board	1/360
Ceiling joists	Other than plaster or gypsum board	1/240
	Plaster or gypsum board	1/360
Floor beams, floor joists and floor decking of plank and beam construction for floor areas other than bedrooms in dwelling units	No ceiling	1/360
	Other than plaster or gypsum board	1/360
	Plaster or gypsum board	1/360
Floor beams, floor joists and floor decking of plank and beam construction for floor areas of bedrooms in dwelling units	No ceiling	1/240
	Other than plaster or gypsum board	1/240
	Plaster or gypsum board	1/360

D. BEARING CAPACITY FOR SOIL AND ROCK

(1) Where footing sizes for shallow foundations are not determined in conformance with Section 15, footings may be designed using maximum allowable bearing pressures in Table 4B.

TABLE 4B - ALLOWABLE BEARING PRESSURES FOR SOILS AND ROCK

Type and Condition of Soil or Rock	Maximum Allowable Bearing Pressure, kN/m^2
Dense or compact sand or gravel[1]	150
Loose sand or gravel[1] incl. pads of coarse granular fill	50
Dense or compact silt[1]	100
Stiff clay[1]	150
Firm clay[1]	75
Soft clay[1]	40
Till	200
Clay shale	300
Sound Rock	500

Note (1): See Appendix A, NBC

(2) Where a soil or rock within a distance equal to twice the footing width below the bearing surface has a lower allowable bearing pressure than that at the bearing surface as shown in Table 4B, the design capacity of the foundation shall not be greater than would cause the weakest soil or rock to be stressed beyond its allowable bearing pressure. In calculating such subsurface pressures, the loads from the footings shall be assumed to be distributed uniformly over a horizontal plane within a frustrum extending downward from the footing at an angle of 60° to the horizontal.

(3) Where a foundation bears on gravel, sand or silt and where the water table is within a distance below the bearing surface equal to the width of the foundation, the allowable bearing pressure shall be 50 per cent of that determined in (1).

(4) Where a foundation is located in an area in which soil movement caused by changes in soil moisture content is known to occur to the extent that it will cause significant damage to a building, measures shall be taken to minimize the effect of such movement on the building.

(5) Walls shall be designed to resist the lateral pressure of the retained material. Walls supporting drained earth may be designed for pressure equivalent to that exerted by a fluid with a density of not less than 480 kg/m^3 and having a depth equal to that of the retained earth. Any surcharge shall be in addition to the equivalent fluid pressure.

NBC

SECTION 5. ROOM AND SPACE DIMENSIONS

A. GENERAL

(1) This Section applies to all buildings regardless of size.

(2) Unless otherwise specifically indicated, this Section applies only to dwelling units that are intended for use on a continuing or year-round basis as the principal residence of the occupant.

(3) Unless otherwise specifically indicated herein, the areas, dimensions and heights of rooms or spaces shall be measured between finished wall surfaces and between finished floor and ceiling surfaces.

(4) Minimum dimensions listed for rooms or spaces in combination with other rooms or spaces refer to the minimum dimension of the combined space.

(5) Minimum floor areas specified in this Section do not include closets or built-in bedroom cabinets unless otherwise indicated.

(6) Two or more areas are considered as a combination room if the dividing wall occupies less than 60 per cent of the separating plane.

(7) Areas and dimensions of rooms or space may be less than required in this Section provided it can be shown that the rooms or spaces are adequate for their intended use, such as by the provision of built-in furniture to compensate for the reduced sizes.

(8) Wherever possible, wheelchair access shall be provided between a sleeping area or bedroom, a bathroom, and the living room or area.

B. CEILING HEIGHTS

(1) Heights of rooms or spaces shall conform to Table 5A

TABLE 5A - ROOM HEIGHTS

Room or Space	Minimum Heights
Living room or space Dining room or space Kitchen or kitchen space	2.3 m over at least 75 percent of the required floor area with a clear height of 2.1 m at any point over the required area
Bedroom or bedroom space	2.3 m over at least 50 percent of the required floor area or 2.1 m over all of the required floor area. Any part of the floor having a clear height of less than 1.4 m shall not be considered in computing the required floor area.
Unfinished basement or cellar including laundry area therein	1.95 m under beams in laundry areas and in any location that would normally be used for passage to laundry and required areas
Service room	1.95 m
Bathroom, water-closet room or laundry area above grade	2.1 m in any area where a person would normally be in a standing position
Passage, hall or main entrance vestibule and finished rooms not specifically mentioned above	2.1 m

(2) The clear height above and below a mezzanine floor assembly shall not be less than 2.15 m.

(3) The clear height in a storage garage shall be not less than 2m.

C. LIVING ROOMS OR SPACES WITHIN DWELLING UNITS

(1) Separate living areas within one or two bedroom dwelling units shall have at least 13.0 m^2 of floor area.

(2) Where the dwelling unit contains more than two bedrooms, floor areas required for a living room in (1) above shall be increased by at least 1.0 m^2 for each additional bedroom contained in the dwelling unit.

(3) Where the area of a living space is combined with a kitchen and dining area in other than a bachelor dwelling unit, the living area alone, as required in (1) and (2), may be reduced by 2.0 m^2

(4) Where the area of a living space is combined with a kitchen and dining area in a bachelor dwelling unit, the living area alone shall be at least 11 m^2.

(5) Living rooms or areas shall have no dimension less than 3 m within the required area.

D. DINING ROOMS OR SPACES WITHIN DWELLING UNITS

(1) In one or two bedroom dwelling units, a separate dining room shall have a minimum floor area of 6 m^2.

(2) When dining spaces are combined with one or more other spaces, the area required in (1) may be reduced by 1.0 m^2.

(3) Where the dwelling unit contains more than two bedrooms, floor areas required for dining spaces within dwelling units in (1) or (2) above shall be increased by at least 1.0 m^2 for each additional bedroom contained in the dwelling unit.

(4) In bachelor dwelling units a dining area shall have a minimum floor area of 4 m^2.

(5) Except as permitted in (6), a dining room or space combined with another space shall have no dimension less than 2.3 m within the required area measured between wall faces or a wall face and a built-in cabinet or appliance.

(6) When a required dining area is provided in a kitchen or serves a bachelor dwelling unit, the minimum dimension of such space may be reduced to 1.7 m.

E. KITCHENS WITHIN DWELLING UNITS

(1) Kitchen areas within one or two-bedroom dwelling units shall have at least 6 m^2 of floor area, including the area occupied by the base cabinets.

(2) Kitchen areas within bachelor dwelling units shall have at least 4.2 m^2 of floor area, including the area occupied by the base cabinets.

(3) Where kitchen spaces are combined with one or more other spaces, the area required in (1) may be reduced by 1.8 m^2.

(4) Where the dwelling unit contains more than two bedrooms, floor areas required for kitchen spaces within dwelling units in (1) or (3) above, either as separate rooms or in combination with other spaces, shall be increased by at least 1.0 m^2 for each additional bedroom contained in the dwelling unit.

(5) At least 900 mm clearance shall be provided in front of base cabinets, work surfaces, counter tops and appliances.

(6) Except as provided in (7), every dwelling unit shall have a kitchen counter at least 550 mm in depth providing at least 1.5 m^2 of work surface, including the area occupied by the sink, and a 2000 mm run of cabinet front. Counter work surface depth greater than 550 mm shall not be included in calculating the required area.

(7) Every bachelor dwelling unit shall have a kitchen counter at least 550 mm in depth providing at least 1.0 m^2 of work surface,including the area occupied by the sink, and 900 mm run of cabinet front. Counter work surface depth greater than 550 mm shall not be included in calculating the required area.

(8) In addition to the base cabinets described in (6), at least 2 m^2 of shelf area not more than 2 m above the floor shall be provided. Of this area, 1.5 m^2 shall be at least 280 mm in depth with at least 210 mm clearance above the shelves. The remaining 0.5 m^2 shall have a depth of at least 130 mm with at least 130 mm clearance above the shelf. The maximum depth for computing shelf areas shall be 280 mm.

(9) In bachelor dwelling units, the shelf area required in (8) may be reduced to 1.5 m^2, with 1.1 m^2 of this area to be at least 280 mm in depth, and with at least 210 mm min. clearance between shelves.

(10) Except in bachelor dwelling units, a minimum of 2 m^2 of shelving shall be provided for the storage of bulk goods in the kitchen or general storage area, in addition to the requirements of (8). The minimum depth of such shelving shall be 600 mm.

F. BEDROOMS OR SPACES IN DWELLING UNITS AND DORMITORIES

(1) Except as provided in (2) and (3), bedrooms in dwelling units shall have at least 7 m^2 of floor area where built-in cabinets are not provided and 6 m^2 of floor area where built-in cabinets are provided. The minimum dimension within the required area shall be 2 m.

(2) Except as provided in (3), at least 1 bedroom in every dwelling unit shall have at least 9.8 m^2 of floor area where built-in cabinets are not provided and 8.8 m^2 of floor area where built-in cabinets are provided. The minimum dimension within the required area shall be 2.7 m.

(3) Bedroom spaces in combination with other spaces in dwelling units shall have at least 4.2 m^2 of floor area and have no dimension less than 2 m within the required area.

(4) Sleeping rooms other than in dwelling units shall have at least 7 m^2 of floor area per person for single occupancy and 4.6 m^2 per person for multiple occupancy. The minimum dimension within the required area shall be 2 m.

G. BUILT-IN BEDROOM CABINETS

(1) A built-in cabinet in the first bedroom shall provide a storage volume of least 0.75 m^3 within 1.5 m of the floor when the bedroom is less than 9.8 m^2.

(2) A built-in cabinet in other than the first bedroom shall provide a storage volume of at least 0.35 m^3 within 1.5 m of the floor when the bedroom area is less than 7 m^2.

(3) Built-in cabinets shall consist of shelves with door fronts or drawers.

(4) When required cabinet storage is by means of shelves, at least 2.5 m^2 shall be provided for the first bedroom and 1.25 m^2 for additional bedrooms. Shelves shall be at least 300 mm but not more than 450 mm in depth. The distance between shelves shall be not less than 1/2 the depth.

(5) When required cabinet storage is provided by drawers, the drawers shall be not more than 1200 mm wide, not more than 300 mm in height and not more than 600 mm in depth.

H. COAT AND CLOTHES CLOSETS

(1) At least 1 clothes closet shall be provided in each bedroom.

(2) A coat closet shall be provided in the main entrance vestibule of a dwelling, or convenient to the main entrance. For other entrances provided with a vestibule as required in 5L, the area required for a coat closet may instead be added to the required area of a vestibule, if at least 8 double heavy-duty coat hooks are installed in the vestibule.

(3) Except as provided in (2), a minimum of four double, heavy-duty coat hooks shall be provided in each entrance vestibule of a dwelling unit.

(4) Coat closets shall be at least 750 mm deep.

(5) Coat closets shall have an area of at least 0.9 m^2 and clothes closets shall have at least 0.55 m^2 of floor area. At least 50 per cent of the required area shall be horizontal and not more than 300 mm above the room floor level. Such closets shall have a minimum height of 2 m over the required floor area.

(6) Walk-in closets shall have at least 2 m head room over the required area.

(7) Clothes closets shall be at least 550 mm deep when the width of the opening is at least 530 mm, and at least 350 mm deep when the opening is 1200 mm wide or more.

(8) A shelf not less than 280 mm deep with a clearance of not less than 200 mm above it shall be provided in coat and clothes closets.

I. LINEN CLOSETS

(1) A linen closet shall be provided in each dwelling unit and shall have a shelf area of not less than 0.55 m^2 for 1-and 2-bedroom dwelling units. Additional shelf area of 0.2 m^2 shall be provided for each additional bedroom.

(2) The maximum depth of shelf to be used in calculating the shelf area shall be 600 mm.

(3) Shelves shall have not less than 350 mm depth, 450 mm width and 300 mm clearance above shelves.

J. BATHROOM AND WATER-CLOSET ROOMS

(1) In every dwelling unit, an enclosed space of sufficient size shall be provided to accommodate a bathtub, water closet and lavatory.

(2) A janitor's toilet room shall be provided adjacent to a combustion equipment room (or other service room) in an apartment building when a dwelling unit is not provided for the janitor.

(3) At least 530 mm clearance shall be provided in front of the tub or shower stall to an opposite wall face or 450 mm in front to another fixture, over at least a 600 mm length of the bathtub or shower.

(4) The centreline of the water closet shall be at least 380 mm away from an adjacent side wall and from a vanity. At least 450 mm clearance shall be provided in front of the water closet to the opposite wall or another fixture.

(5) The centreline of a lavatory shall be at least 380 mm away from an adjacent side wall. At least 530 mm clearance shall be provided in front of the lavatory to an opposite wall or 450 mm clearance in front to another fixture.

(6) A mirror not less than 300 mm by 450 mm in size shall be installed over each lavatory in bathrooms and washrooms. Such mirrors shall conform to Type 1B polished plate or float glass for high humidity use in CAN2-12.5, "Mirrors, Silvered", and shall be so labelled.

(7) Each bathroom in a dwelling unit shall be provided with a wall cabinet with shelves, or a vanity or cupboard with equivalent shelf space. Wall cabinets shall be at least 230 mm in height or width and at least 0.15 m^2 in overall size. At least one such cabinet, vanity or cupboard shall be provided with a lock or child-resistant fastening device.

(8) Except for bachelor dwelling units, at least one bathroom access that does not enter through a bedroom shall be provided to the required bathroom.

K. HALLWAYS

The width of a hallway within a dwelling unit shall be at least 860 mm, except that in buildings not exceeding 4.3 m in width, the hallway width may be 710 mm where a second exit is provided near the end of the hallway farthest from the living area.

L. ENTRANCES

(1) Except for a dwelling unit with a door opening from a public corridor or passageway, and except for a dwelling unit that has a ground floor area of less than 75 m^2 and that satisfies the requirements of 9 I, a dwelling unit shall have at least two entrances located on different faces of the building.

(2) Except as provided in (3), every door that provides access from the outdoors to an entrance in conformance with (1) shall open into an unheated space or unheated vestibule having an area of not less than 2.25 m^2, with a minimum clear width of 1.5 m.

(3) In communities and areas where, in the opinion of the authority having jurisdiction, entrance doors are not susceptible to blockage by drifting snow, one of the entrances required in (1) may be provided for summer use only. Doors for summer use, such as sliding or french doors, need not open onto an unheated space or vestibule.

M. COMBUSTION EQUIPMENT ROOMS

(1) A combustion equipment room may contain mechanical or electrical equipment in addition to combustion appliances, but no provision shall be made in it for general storage or laundry facilities.

(2) All walls, floors and ceilings that separate a combustion equipment room from the habitable spaces of a dwelling unit or building shall be constructed with an air barrier, installed in conformance with Subsection 26C.

(3) Fire separations of a combustion equipment room shall be in conformance with Subsection 10 J.

(4) A combustion equipment room shall be provided with a tightly-sealed, weatherstripped door or other closure in conformance with Subsection 6E, swinging into the room and equipped with a self-closing device conforming with 6H(9).

(5) All equipment in a combustion equipment room shall be located so as to permit access for servicing.

(6) Provision shall be made for the replacement of all equipment located in a combustion equipment room.

(7) Clearances around combustion equipment in a combustion equipment room shall be in conformance with Section 34.

N. UTILITY ROOMS

(1) All equipment in utility rooms shall be located so as to permit access for servicing.

(2) Provision shall be made to permit the replacement of all equipment located in utility rooms.

(3) Utility rooms that may be used for the storage of hazardous substances shall be constructed in conformance with the requirements governing the storage of such substances in Part 3 of the NBC [see also 33B(6)].

(4) Fire separations of a utility room shall be in conformance with Subsection 10 I.

O. LAUNDRY AND LAUNDRY SPACE

(1) Laundry facilities shall not be located in a combustion equipment room.

(2) Where an automatic washer or dryer is not provided, a space to accommodate such equipment shall be provided. Each automatic washer or dryer shall be assumed to occupy a space of at least 760 mm in width and 710 mm in depth, with a clear space of at least 900 mm in front of the equipment.

(3) A clearance of at least 900 mm shall be provided at the front of an automatic washer or dryer.

(4) Where laundry facilities are shared, the laundry space described in (1) shall be provided for each 20 dwelling units or fraction thereof.

P. GENERAL STORAGE

(1) Except as provided in (2) and (3), every dwelling unit shall have a storage volume of at least 5.65 m^3, plus at least 2.12 m^3 for each bedroom. Such storage space shall have at least 1.8 m height over at least 50% of the required space and at least 1.2 m height over the remainder of the required space. Required storage space shall be separate from furnished areas, and access to storage space shall be independent from other dwelling units.

(2) In a building equipped with an elevator, a storage volume of at least 5.65 m^3 conforming to the requirements in (1) shall be provided for each dwelling unit.

(3) Where a portion of the required storage space consists of communal storage as described in (4), the required independent storage volume for each dwelling unit may be reduced to 4.25 m^3 for a dwelling unit with not more than one bedroom plus 0.85 m^3 for each additional bedroom. Such storage space shall be at least 1.8 m in height and at least 600 mm in depth. When located within a dwelling unit such storage shall be separate from other space. When located outside a dwelling unit the storage space for each dwelling unit shall be in a separate lockable enclosure with direct and convenient access.

(4) Communal storage referred to in (3) shall have an area of at least 5.5 m^2 when such storage serves not more than 10 dwelling units plus an additional 0.55 m^2 for each dwelling unit in excess of 10, except that such storage need not exceed 22 m^2.

SECTION 6. DOORS

A. GENERAL

(1) This Section applies to all buildings regardless of size.

(2) NBC This Section applies to doors, to glazed areas in doors and to sidelights for doors. (See also Sections 9 and 10)

(3) Thresholds in the access routes required in Subsection 9B to be constructed to accommodate physically handicapped persons shall be not greater than 13 mm in height, and shall be sloped to facilitate the passage of wheelchairs.

(4) Any door required to have a self-closing device shall have adequate strength to withstand the forces imposed by such devices.

B. REQUIRED DOORS

(1) A door shall be provided at each entrance to a dwelling unit, vestibule, bedroom, bathroom, water-closet room, shower room, service room and laundry room.

(2) In buildings containing more than 1 dwelling unit, doors shall be provided at the exterior entrances, laundry or drying rooms, storage rooms, public water-closet rooms, garbage rooms, combustion equipment rooms, recreation rooms and any other locations required by Section 10.

C. DOORWAY SIZES

(1) Except as provided in (2) and (3), doorway openings within dwelling units shall be designed to accommodate not less than the door sizes shown in Table 6A for swing-type doors. Where folding doors are to be provided, the same openings apply.

(2) NBC A doorway to at least 1 bathroom in a dwelling, as described in 5J(1) shall accommodate a door not less than 760 mm in width.

(3) Doors to public water-closet rooms shall be not less than 810 mm in width and 2030 mm in height.

TABLE 6A - MINIMUM SIZE OF DOORS

At Entrance to:	Width, mm	Height, mm
Dwelling unit (required entrance) Vestibule or entrance hall	810	1980
Stairs to a floor level that contains a finished space. All doors in at least 1 line of passage from the exterior to the basement. Service Rooms	810	1980
Walk-in closet	610	1980
Bathroom, water-closet room, shower room	610(1)	1980
Rooms located off hallways that are permitted to be 710 mm wide	610	1980
Rooms not mentioned above, exterior balconies	760	1980

NOTE (1): except as provided in C(2)

D. INTERIOR WOOD DOORS

(1) The construction of interior wood doors shall conform to CSA 0132.2, "Wood Doors."

(2) Interior wood doors in dwelling units other than closet doors or cupboard doors shall be at least 35 mm thick.

(3) Interior wood doors to rooms or spaces used for storage, laundry, drying, vestibules, recreation or water closets in apartment buildings, but not within dwelling units, shall be at least 45 mm thick.

E. EXTERIOR DOORS

(1) Any door leading from a heated space to the outdoors or to an unheated space shall be considered to be an exterior door.

(2) Wood doors shall conform to CSA 0132.2, "Wood Doors".

(3) Wood doors shall be at least 45 mm thick, and shall have a thermal resistance of not less than 0.38 RSI when opening from an unheated vestibule into a heated space, and not less than 0.70 RSI when opening from a heated space to the outdoors, unless a storm door is provided.

(4) Aluminum frame sliding doors shall conform to CGSB 82-GP-1M, "Doors, Glass, Aluminum Frame, Sliding Standard-Duty" or to CGSB 82-GP-2M, "Doors, Glass, Aluminum Frame, Sliding, Medium-Duty."

NBC

(5) Insulated steel doors shall conform to CGSB 82-GP-5M, Standard for "Doors, Insulated, Steel" and shall have a thermal resistance of not less than 1.23 RSI.

(6) Storm or combination doors shall be at least 35 mm thick for wood doors and 25 mm for metal doors.

(7) Weatherstripping made of metal, plastic, rubber, wood or fabric or combination of these materials shall be installed at the perimeter of all exterior door openings.

(8) Where an exterior door opening is not completely protected from wind-blown snow or rain, it shall be provided with a sill that slopes to the exterior and the frame and sill shall be caulked with suitable caulking to prevent the entry of water.

(9) Wood door frames shall be one of the species indicated in Clause 3.1.1 of CSA 0132.1-M, "Wood Windows". Allowable defects shall not exceed those described in Clause 3.2.1. of the same Standard. Such frames shall be treated with preservatives in accordance with Clauses 5.2 and 5.3 of CSA 0132.1-M, "Wood Windows."

(10) Steel door frames shall be painted with a rust inhibitive paint or otherwise treated before erection to prevent corrosion. Such frames shall incorporate a thermal break to prevent a continuous metal path from the interior to the exterior [see also F(8)].

(11) Exterior swing door and sliding door assemblies located in the building envelope shall be designed to limit the rate of air infiltration to not more 2.5 L/s for each square metre of door area when tested at a pressure differential of 75 Pa in conformance with ASTM E283-73, "Standard method of Test for Rate of Air Leakage through Windows, Curtain Walls and Doors."

(12) Caulking material to reduce air infiltration shall conform to the requirements of Sub-section 28D.

F. GLASS

(1) NBC The maximum area of individual panes of glass for doors shall conform to Table 6B.

NBC

TABLE 6B - Maximum Glass Area for Doors, m^2

Glass Thickness, mm	Type of Glass					
	Annealed	Annealed Multiple -glazed Factory Sealed Units	Laminated	Wired	Heat Strengthened	Fully tempered
3	0.50	0.70	(2)	(2)	1.00	1.00
4	1.00	1.50	(2)	(2)	1.50	4.00
5	1.50	1.50	(2)	(2)	1.50	No limit
6	1.50	1.50	1.20	1.00	1.50	No limit

NOTE (1): See Appendix A, NBC
NOTE (2): Not generally available

(2) NBC Glass in doors and in sidelights for doors shall conform to (3).

(3) Glass side lights greater than 500 mm in width that could be mistaken for doors, glass in storm doors and glass in sliding doors within or at every entrance to a dwelling unit and in public areas shall be safety glass of the laminated or tempered type conforming to CAN2-12.1, "Glass, Safety, Tempered or Laminated," or shall be of wired glass conforming to CAN2-12.11, "Glass, Wired, Safety."

(4) Glass in entrance doors to dwelling units and in public areas, other than the entrance doors described in (3), shall be safety glass or wired glass of the type described in (3) where the glass area exceeds 0.5 m^2 and extends to less than 900 mm from the bottom of the door.

(5) Mirrored glass doors may be used only at the entrance to clothes closets. Such doors shall be reinforced with hardboard, plywood or particleboard securely fastened to the back of the mirror unless the glass is safety glass of the laminated or tempered type.

(6) Except as provided in 7 E(3), every glass or transparent door accessible to and used by the public shall be equipped with hardware, bars or other permanent fixtures designed so that the existence and position of such door will be readily apparent.

(7) Glass, other than safety glass, shall not be used for a shower or bathtub enclosure.

(8) Glazing in doors or sidelights separating an unheated vestibule from heated space shall have a thermal resistance of not less than RSI 0.29

(9) A thermal break shall be incorporated in metal door frames where 2 doors are provided, or in the metal double glazing frame where a single door is provided, to reduce the risk of surface condensation on the frame.

G. GARAGE DOORS

(1) Garage doors shall be not less than 2.44 m wide for 1-car width and 4.27 m wide for 2-car width. The height of the clear opening with the door in the open position shall be not less than 1.93 m. For parking garages, garage doors shall be not less than 3.05 m wide for 1-way traffic and 4.88 m for 2-way traffic. Hardware associated with the operation of garage doors shall not project more than 100 mm into the garage door opening.

(2) Wood doors shall be at least 44 mm thick in side hinged or 1-piece overhead and not less than 35 mm thick if sectional overhead.

(3) Steel and aluminum doors shall be made with suitably braced frames clad with not less than 0.61 mm galvanized steel prepared for paint or 0.81 mm thick aluminum.

(4) Overhead doors shall have suitable springs or counterbalances and weather stops.

(5) Side hinged doors shall be equipped with hinges to carry the weight of the door without sagging.

(6) Garage doors shall be equipped with locks.

(7) Garage doors to heated garages shall have a thermal resistance of not less than 0.38 RSI.

H. HARDWARE

(1) Hinges for exterior doors shall consist of "18-8" stainless steel; or brass or bronze of a type conforming to CGSB 69-GP-1M, "Hinges, Hardware, Builders," equipped with ball bearings; or steel, electroplated with 0.013 mm zinc or cadmium and chromate treated; or steel, pretreated and primed for painting in accordance with CGSB 69-GP-1M, "Hinges, Hardware, Builders."

(2) Except as provided in (4), all doors shall be hung with at least three 89 mm by 89 mm solid butt hinges at least 2.5 mm thick.

(3) Hinges for interior doors shall be the same as required in (1), except that bronze or brass hinges need not be ball-bearing type or they may be of steel, plated with chrome, brass, bronze, nickel or cadmium in accordance with CGSB 69-GP-1M, "Hinges, Hardware, Builders."

(4) Interior swing type hollow core doors within dwelling units shall be hung with at least two 76 mm by 76 mm solid butt hinges at least 2.0 mm thick. Interior swing type solid core doors within a dwelling unit shall be hung with at least three 76 mm x 76 mm solid butt hinges at least 2.0 mm thick.

(5) Screws, bolts and other fastening devices for use with door hinges shall be made from materials compatible with and having the same finish as the door hinges.

(6) All exterior doors to a dwelling unit shall be fitted with devices capable of locking the door from either side and capable of being unlocked from the inside without the use of a key, except that exterior doors in addition to the required doors need not be capable of being locked from the outside. Exterior doors to balconies more than 1.8 m above grade shall be designed to not lock automatically.

(7) Subject to the requirements of 9F(4), exterior doors located in a building envelope shall be fitted with a self-closing device conforming to the requirements of (9) and located on the warmer side of the door.

(8) Doors to combustion equipment rooms and doors between a dwelling unit and an attached garage shall be fitted with a self-closing device conforming to the requirements of (9) and located on the warmer side of the door. [See Article 5M(5)].

(9) Self-closing devices required in (7) and (8) shall conform to one of the following standards:

CGSB 69-GP-2M, "Door Closers, Overhead, Surface Mounted"

CGSB 69-GP-10M, "Door Closers, Rectangular, Overhead, Surface Mounted (Excluding Top Jamb Application)"

CGSB 69-GP-11M, "Door Closers, Rectangular, Overhead, Surface Mounted (Top Jamb Application)"

(10) For additional requirements for exit door hardware see Subsection 9F.

(11) Door stops shall be provided wherever necessary to prevent damage to interior wall finish.

SECTION 7: WINDOWS

NBC

A. GENERAL

(1) NBC Windows shall conform to the requirements of this Section. (See also Sections 10 and 33 for fire protection and ventilation)

(2) Windows shall be designed and installed so that they shed water.

(3) NBC Except as required in (15), the minimum window glass area for rooms in buildings of residential occupancy or which are used for sleeping shall conform to Table 7A. The unobstructed glass area of a door or skylight is considered equivalent to that of a window.

(4) Wherever practicable, windows shall be provided to light corridors, stairways and similar public spaces in buildings.

(5) The frames of openable windows shall be constructed to permit the installation of storm sash and screens. Vent closures shall be constructed to permit the installation of screens.

(6) A thermal break shall be incorporated in metal window frames to reduce the risk of surface condensation on the frame. (See Section 6 for door side lights)

(7) Except as provided in (8), and (11), all windows and skylights shall have a thermal resistance of at least 0.45 RSI. Triple glazing with at least 6 mm air spaces, or double glazing with at least 6 mm air space and with a storm sash shall be considered to provide the required thermal resistance.

(8) Where an enclosed unheated space, such as a sun porch, enclosed verandah or vestibule, is separated from a heated space by glazing, the unheated enclosure may be considered to provide a thermal resistance of 0.16 RSI or the equivalent of one layer of glazing.

TABLE 7A

MINIMUM GLASS AREAS FOR ROOMS OF RESIDENTIAL OCCUPANCY

Location	Unobstructed Glass Area	
	With No Electric Lighting	With Electric Lighting
Laundry, basement recreation room, unfinished cellar or basement	4 percent of area served	Windows not required
Water-closet room	0.37 m^2	Windows not required
Kitchen, kitchen space, kitchen alcove	5 percent of area served	Windows not required
Living and Dining rooms	8 percent of area served	8 percent of area served
Bedrooms and other finished rooms not mentioned above	5 percent of area(1) served	5 percent of area(1) served

NBC

NBC NOTE 1: See A(15)

(9) Except as provided in (11), (12) and Subsection 26B, the total area of glazing that separates heated space from unheated space or the outdoors, including glazing for doors and skylights, shall not exceed 12 per cent of the floor surface area of the storey served by the glazed areas and shall not exceed 32 per cent of the total area of the exterior walls of that storey. (In the case of a sloping wall, the area of the opaque portion of the wall is calculated as its projected area on a vertical plane.)

(10) Except for required entrance and exit doors, the full area of a door forming part of the building envelope shall be considered to be window area for the purposes of the provisions of (9).

(11) Where the thermal resistance of glazing is different from that required in (7), the area of such glazing for the purpose of applying (9), may be assumed as being equal to the actual area multiplied by the ratio of the required thermal resistance to the actual thermal resistance of the glazing.

(12) The area of glazing that contains clear glass or that has a shading coefficient of more than 0.70 that is unshaded in the winter and faces a direction within 45 degrees of due south may be assumed to be 50 per cent of its unshaded area in calculating the maximum area of glazing in (9) and (11), provided the building is designed with a system that is capable of distributing the solar heat gain from such glazed areas throughout the building.

(13) Windows in a building envelope shall be designed to limit the rate of air infiltration to not more than 0.25 L/s for each metre of sash crack when tested at a pressure differential of 75 Pa in conformance with ASTM E283-73, "Standard Method of Test for Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors."

(14) Non-vitreous glazing and materials which can be broken only with difficulty shall not be used except where specifically permitted by the authority having jurisdiction.

(15) NBC Except where a bedroom door provides access directly to the outdoors, each bedroom shall have at least one outside window openable from the inside without the use of tools or special knowledge. Such windows shall provide an unobstructed opening of not less than 380 mm in either height or width and 0.35 m^2 in area. [See also 9I(2)]

(16) NBC Where a window required in (15) opens into a window well, a clearance of at least 550 mm shall be provided in front of the window. Where the sash swings towards the window well, the operation of the sash shall not reduce the clearance in a manner that would restrict escape in an emergency.

(17) Materials and construction of storm sashes and other removable glazing shall conform to provisions in Subsections C, D, E, and H of this Section.

B. WINDOW STANDARDS

NBC

Unless otherwise specified in this Section, windows shall conform to one of the following:

CSA 0132.1, "Wood Windows"
CSA A274, "Vinyl Windows"
CAN 2-12.8, "Insulating Glass Units"
CGSB 63-GP-2, "Windows, Extruded Aluminum, Vertical and Horizontal Sliding, Medium Duty"
CGSB 63-GP-3, "Windows, Extruded Aluminum, Vertical and Horizontal Sliding, Standard Duty"
CGSB 63-GP-5 "Windows, Steel, Vertical and Horizontal Sliding, Standard Duty"
CGSB 63-GP-6 "Windows, Steel, Vertical and Horizontal Sliding, Medium Duty"

Windows manufactured in conformance with CGSB window standards may be either Grade 1 or Grade 2, regardless of height above grade.

C. GLASS

NBC

(1) Glass shall conform to one of the following:

CAN2-12.1, "Glass, Safety, Tempered or Laminated",
CAN2-12.2, "Glass, Sheet, Flat, Clear",
CAN2-12.3, "Glass, Polished Plate or Float, Flat, Clear",
CAN2-12.4, "Glass, Heat-Absorbing",
CAN2-12.8, "Insulating Glass Units",
CAN2-12.10, "Glass, Light and Heat Reflecting", or
CAN2-12.11, "Glass, Wired, Safety".

NBC

(2) Thickness of glass supported on 4 edges shall conform to Table 7B. Glass supported on 2 edges shall be designed in conformance with Part 4 of NBC.

NBC

TABLE 7B. Maximum Glass area for Windows, m^2

Glass Thickness, mm	Type of Glass					
	Annealed	Annealed Multiple -glazed Factory Sealed Units	Laminated	Wired	Heat Strengthened	Fully tempered
2	0.50	0.70	(1)	(1)	(1)	(1)
3	1.30	1.95	(1)	(1)	(1)	(1)
4	2.20	3.30	(1)	(1)	4.40	8.80
5	3.10	4.65	1.85	(1)	6.20	12.40
6	4.15	6.20	2.50	2.00	8.30	No limit
8	6.50	9.75	3.90	(1)	13.00	No limit
10	9.20	No Limit	5.50	4.60	No Limit	No limit
12	12.25	No Limit	7.35	(1)	No Limit	No limit

NOTE (1): Not generally available

D. CAULKING AND GLAZING

(1) Sealing compound used in the glazing of factory-sealed double-glazed units shall be compatible with the material used to edge-seal the units.

(2) For caulking of window frames and trim, see Subsection 28D.

E. WINDOWS IN PUBLIC AREAS

(1) NBC Except as provided in (3), transparent panels that could be mistaken as a means of egress shall be protected by barriers or railings.

(2) Windows in exit stairways that extend to less than 1070 mm above the landing shall be protected by railings or barriers located approximately 1070 mm above such landings.

(3) Sliding glass partitions which separate a public corridor from an adjacent occupancy, and which are open during normal working hours, need not conform to (1) and Article 6F(4), except that such partitions shall be suitably marked to indicate their existence and position.

(4) Windows in public areas that extend to less than 1 m from the floor and are located above the second storey in buildings of residential occupancy, shall be protected by barriers or railings 1 m above the floor, or the windows shall be non-openable and designed to withstand the lateral loads for balcony guards in Part 4 of the NBC.

F. WINDOWS IN EXPOSING BUILDING FACES

NBC The location and area of windows in each exposing building face shall conform to Subsection 10N.

G. HARDWARE

(1) Material for window hinges shall conform to the requirements in Subsection 6H for door hinges.

(2) Every openable window shall be equipped with corrosion-resistant locking devices controlled from the interior.

(3) Either the upper or lower sash of vertical sliding wood sash windows shall be balanced. An unbalanced upper sash shall be fixed in position by means of a block or other sash holding device.

(4) Corrosion-resistant sash lifts shall be provided for vertical sliding sash.

(5) Hinged sash in other than unfinished basements shall be equipped with devices to hold the sash in any position.

NBC

H. SKYLIGHTS

(1) NBC Plastic skylights shall conform to CGSB 63-GP-14, "Standard for Skylights, Plastic".

(2) NBC Factory-built skylights shall meet the performance requirements of CGSB 63-GP-14. See also NBC 3.1.4.5(2.H)

SECTION 8. STAIRS, RAMPS, HANDRAILS AND GUARDS

A. SCOPE

(1) This Section applies to the design and construction of interior and exterior stairs, steps, ramps, railings and guards.

(2) Where the stair forms part of an exit, the appropriate requirements in Section 9 and 10 shall apply.

(3) Where stairs are located within dwelling units, this Section shall apply to all buildings, regardless of size.

B. GENERAL

(1) Treads and risers shall have uniform rise and run in any one flight.

(2) Except for interior stairs within a dwelling unit, at least 3 risers shall be provided for interior stairs.

(3) Measures shall be taken to prevent the deposition of snow from roofs onto stairs, ramps or landings, by the design of the roof or by suitable protective coverings. [See also 9F(10)]

C. STAIR DIMENSIONS

(1) Interior stairs within dwelling units to areas used only for storage, laundry and mechanical equipment such as unfinished basements, cellars and attics, shall have a maximum rise of 230 mm, a minimum run of 200 mm and a minimum tread width of 230 mm.

(2) Interior stairs within dwelling units other than those listed in (1), and exterior stairs serving dwelling units, shall have a maximum rise of 200 mm, a minimum run of 230 mm, and a minimum tread width of 250 mm.

(3) Interior stairs not contained within dwelling units and exterior stairs for buildings, except for those serving not more than 1 dwelling unit, shall have a maximum rise of 200 mm, a minimum rise of 125 mm, a minimum run of 230 mm, and a minimum tread width of 250 mm. The product of the run and rise (expressed in millimetres) for such stairs shall be not less than 45,000 nor more than 48,500.

(4) Where the run of any stair is less than 250 mm, a nosing of at least 25 mm shall be provided beyond the face of the riser, or an equivalent back slope on the risers shall be provided.

(5) Except as required in Article 9C (3), exit stairs and stairs used by the public shall have a width, measured between wall faces or guards, of at least 900 mm.

(6) At least 1 stairway between each floor level in a dwelling unit shall have a minimum width between wall faces of at least 860 mm.

(7) The head room measured vertically from a line drawn through the outer edges of the nosings shall be at least 1.95 m for stairs located in dwelling units and 2.05 m for all other stairs.

D. LANDINGS

(1) Except as required in (2), (3), (4) and (5), landings shall be at least as wide and as long as the width of stairs in which they occur.

(2) The length of the landing for exterior stairs serving not more than 1 dwelling unit need not exceed 900 mm, and the length of landing for all other stairs in a straight run need not exceed 1,100 mm.

(3) Where a door swings towards a stair, the full arc of its swing shall be over a landing. Except as provided in (4), a landing shall be provided at the top and bottom of each flight of interior stairs and where a doorway occurs in a stairway.

(4) Where a door occurs at the top of the stair in a dwelling unit, no landing is required between the doorway and the stairs.

(5) A landing with a length at least equal to the width of the door served plus 300mm shall be provided at the top of all exterior stairs, except that a landing may be omitted at a secondary entrance to a building containing a single dwelling unit provided the stair does not contain more than 3 risers.

(6) The landings of exterior stairs shall not have side curbs or solid balusters that will inhibit snow clearance, unless they are specifically designed to prevent snow accumulation by the use of an open grille or other acceptable design.

(7) NBC The vertical height between any landings shall not exceed 3.7 m.

(8) The clear height over landings shall be at least 1.95 m in dwelling units and 2.05 m for other landings.

E. CURVED STAIRS AND WINDERS

(1) Curved stairs used in exits shall conform to the requirements for exit stairs in this Section.

(2) Except as permitted in (3), a curved stair not required as an exit shall have a minimum average run of 200 mm and a minimum run of 150 mm and shall have risers conforming to 8C(1) to 8C(3).

(3) Stairs within dwelling units may contain winders that converge to a centre point provided the winders turn through an angle of not more than 90 deg. and individual treads turn through an angle of 30 deg. Only 1 set of such winders shall be permitted between floor levels.

F. PEDESTRIAN RAMPS

(1) NBC Except as provided in (2), ramps in a barrier-free access shall conform to the requirements of Section 3.7 of the NBC.

(2) The maximum gradient for pedestrian ramps shall be 1 to 12.

(3) NBC Except as required in (1), where a doorway or stairway opens onto the side of a ramp there shall be a level area extending across the full width of the ramp for a distance of at least 300 mm on either side of the wall opening.

(4) NBC Except as required in (1), where a doorway or stairway opens onto the end of a ramp, there shall be a level area extending across the full width of the ramp and along the ramp for at least 900 mm.

(5) Where ramps are installed for use by persons in wheelchairs, such ramps shall be at least 900 mm in width and have nonslip surfaces.

(6) Ramps described in (5) shall have a level area of at least 1.5 m at the top and bottom of the ramp, except that where a doorway at the top of a ramp swings away from the ramp, the depth of the level area at the top of the ramp may be reduced to 900 mm. The level portion at the top of a ramp shall extend at least 300 mm beyond the latch edge of any door.

(7) Where there is an abrupt change in the direction of a ramp described in (5) or where the ramp exceeds 9 m in length, it shall have a level landing at least 1.2 m long, and at least the same width at the ramp at intervals of not more than 9 m.

G. HANDRAILS

(1) Except as permitted in (5) and (6), a handrail shall be provided on at least 1 side of stairs less than 1,100 mm in width, and on 2 sides of stairs 1,100 mm in width or greater.

(2) NBC Except for stairs serving only one dwelling unit, at least 1 handrail shall be continuous throughout the length of the stairway, including landings, except where interrupted by doorways or newels at changes in direction.

(3) NBC Except for stairs serving only 1 dwelling unit, handrails shall be terminated in a manner that will not obstruct pedestrian travel or create a hazard.

(4) NBC Except for stairs serving only 1 dwelling unit, handrails at the sides of stairs and ramps shall extend horizontally at least 300 mm beyond the top and bottom of the stairways or ramps.

(5) Handrails are not required for stairs within dwelling units having not more than 2 risers, or for exterior stairs having not more than 3 risers and serving not more than 1 dwelling unit.

(6) Only 1 handrail is required on exterior stairs having more than 3 risers provided such stairs serve not more than 1 dwelling unit.

(7) Handrails that are required on stairs and ramps shall be not less than 800 mm and not more than 920 mm in height, measured vertically from a line drawn through the outside edges of the stair nosings or from the surface of the ramp.

NBC

(8) A clearance of at least 40 mm shall be provided between each handrail and the wall to which it is fastened.

(9) Handrails shall be so constructed that there will be no obstruction on or above them to break a handhold.

(10) Handrails and stair stringers shall not project more than 100 mm into the required width of stairway.

(11) Where ramps are required to provide access for persons in wheelchairs, a handrail shall be provided on at least 1 side of the ramp where the slope of the ramp exceeds 1 in 20, and on 2 sides where the slope exceeds 1 in 12. Such handrails shall conform to (7) to (10) and shall extend at least 300 mm beyond the top and bottom of the ramp in a manner that will not constitute a hazard.

H. GUARDS

(1) Every exterior landing, porch and every balcony, mezzanine, gallery, raised walkway and roof to which access is provided for other than for maintenance purposes, shall be protected by guards on all open sides where the difference in elevation between adjacent levels exceeds 600 mm, and every exterior stair with more than 6 risers shall be protected with guards on all open sides where the difference in elevation between the adjacent ground level and the stair exceeds 600 mm.

(2) When an interior stair has more than 2 risers, the sides of the stair and the landing or floor level around the stair well shall be enclosed by walls or be protected by guards, except that a stair to an unfinished basement or cellar in a dwelling unit may have 1 unprotected side.

(3) Except as provided in (4) and (5), all guards including those for balconies shall be at least 1,070 mm in height.

(4) Except as provided in (5), guards for stairs shall be at least 900 mm in height measured vertically from a line drawn through the outside edges of the stair nosings, and 1,070 mm in height at landings.

(5) Guards for stairways within dwelling units and stairs serving not more than 1 dwelling unit shall be at least 800 mm measured vertically above a line drawn through the outside edges of stair nosings, and at least 900 mm above landings. All other required guards within dwelling units shall be at least 900 mm in height.

(6) Except for floors of garages in Section 36, a continuous curb at least 150 mm in height and a guard not less than 1,070 mm above the floor level shall be provided at every opening through a garage floor and around the perimeter of such floor and ramps where the exterior walls are omitted where the top of the floor is 600 mm or more above or adjacent ground or floor level.

(7) Openings through a guard on a balcony or an exit stair, except an exit stair serving not more than 1 dwelling unit, shall be of a size as to prevent the passage of a spherical object having a diameter of 100 mm, unless it can be shown that the location and size of such openings which exceed this limit do not represent a hazard.

(8) Guards around exterior balconies shall be designed so that no member, attachment or opening located between 100 mm and 900 mm above the balcony floor will facilitate climbing.

(9) Guards for ramps including vehicular ramps shall conform to the requirement for guards for stairs in (3), (4) and (7).

I. CONSTRUCTION

(1) Exterior concrete stairs with more than 2 risers and 2 treads shall be supported on unit masonry or concrete walls or piers at least 150 mm by 150 mm, or shall be cantilevered from the main foundation wall. When such steps are cantilevered from the foundation wall, they shall be constructed and installed in conformance with Subsection 8J. The depth below grade for foundations for exterior steps shall conform to the requirements in Section 12. Exterior wood steps shall not be in direct contact with the ground unless suitably treated with a wood preservative.

(2) Wooden stair stringers shall have a minimum effective depth of 90 mm and an over-all depth of at least 235 mm. Stringers shall be supported and secured top and bottom. Stringers shall be at least 25 mm in actual thickness if supported along their length and 38 mm actual thickness if unsupported along their length. Stringers shall be spaced not more than 900 mm o.c. in dwelling units and 600 mm o.c. when located in other than dwelling units, except that in dwelling units where risers support the front portion of the tread, the space between stringers shall not exeed 1,200 mm unless the stringers are designed for wider spacings.

(3) Lumber or plywood treads for stairs within dwelling units shall be at least 25 mm actual thickness, except that if open risers are used, and the distance between exceeds 750 mm, the treads shall be at least 38 mm actual thickness.

(4) The finish for treads and landings of interior stairs in dwelling units, other than stairs to unfinished basements and cellars, shall consist of hardwood, vertical grain softwood, resilient flooring or other material providing equivalent performance.

(5) NBC Treads and landings of interior and exterior stairs and ramps, other than those within dwelling units, shall have a slip-resistant finish or be provided with slip-resistant strips which extend not more than 1 mm above the surface.

J. CANTILEVERED PRECAST CONCRETE STEPS

(1) Exterior concrete steps and their anchorage system that are cantilevered from a foundation wall shall be designed and installed to support the loads to which they may be subjected.

(2) Cantilevered concrete steps in (1) shall be anchored to concrete foundation walls at least 200 mm thick.

(3) Suitable precautions shall be taken during back-filling and grading operations to ensure that subsequent freezing of the soil will not cause uplift forces on the underside of cantilevered concrete steps to the extent that the steps or the walls to which they are attached will be damaged.

SECTION 9. MEANS OF EGRESS

A. SCOPE

(1) This Section applies to requirements that are designed to permit the safe and convenient access to the exterior of a building, to a public thoroughfare or to acceptable open space.

(2) Stairways, handrails and guards in a means of egress shall conform to the requirements in Section 8 as well as to the requirements in this Section.

(3) Flame-spread ratings, fire-resistance ratings and fire-protection ratings shall conform to Section 10.

B. GENERAL

(1) An access to exit shall be provided from every roof intended for occupancy and from every podium, terrace, platform or contained open space. Where a roof is intended for an occupant load of more than 60 persons, at least 2 separate means of egress shall be provided from the roof to stairs designed in conformance with the requirements for exit stairs and located remote from each other. Where a podium, terrace, platform or contained open space is provided, egress requirements shall conform to the appropriate requirements for rooms or suites in 9G(4).

(2) Exits may consist of doorways, passageways, ramps, stairways and horizontal exits. Fire escapes may be used as exits on existing buildings provided they are designed and installed in conformance with Part 3 of the NBC.

(3) Elevators, slide escapes or windows shall not be considered as being part of a required means of egress.

(4) An exit shall be designed for no purpose other than for exiting, except that an exit may also serve as an access to a floor area.

(5) NBC Ancillary rooms such as storage rooms, washrooms, toilet rooms, laundry rooms and service rooms shall not open directly into an exit serving more than one unit.

(6) Doors to combustion equipment rooms and garbage rooms shall swing into the room served.

(7) Fire escapes shall not be installed on any new building.

(8) Where a horizontal exit is used, it shall conform to Part 3 of the NBC.

(9) NBC Except as provided in (10), every building shall provide barrier-free access in conformance with Section 3.7 of the NBC. Where barrier-free access is provided to any storey above the first storey, the requirements of Article 3.3.1.5 of the NBC shall apply.

(10) NBC Barrier-free access described in (9) need not be provided for in apartment buildings without elevators or houses, including semi-detached, duplexes, triplexes, townhouses, boarding houses and rowhouses.

(11) Unless otherwise permitted by the authority having jurisdiction, every building required by Section 37 to have an elevator shall have an entrance designed for use by physically disabled persons, opening to the outdoors at sidewalk level or to a ramp leading to a sidewalk or other approved space. The location of such an entrance shall be clearly indicated by signs conforming Section 3.7 of the NBC.

(12) Unless otherwise permitted by the authority having jurisdiction, every building required by Section 37 to have an elevator shall provide access for physically disabled persons from the entrance described in (11) to each dwelling unit, public space such as shared recreational facilities, shared laundry rooms, mail boxes and garbage disposal facilities, and to at least 1 elevator.

(13) Access for physically disabled persons described in (10) and (11) shall be constructed to facilitate the passage of wheelchairs, and any abrupt change in elevation in a floor area shall be provided with ramps conforming to the requirements in Subsection 8F.

(14) Vestibules that provide access for physically disabled persons, including those in washrooms and toilet rooms, shall be designed to permit movement of wheelchairs between the doors.

C. DIMENSIONS OF MEANS OF EGRESS

(1) This Subsection applies to every means of egress except exits that serve not more than 1 dwelling unit and access to exits within dwelling units.

(2) The occupant load of floor areas or part of floor areas used in determining the minimum required width of a means of egress shall be the number of persons for which such areas are designed, but not fewer than 2 persons per bedroom or sleeping area, except that in dormitories the maximum area to be assumed per person shall be 4.6 m^2 unless otherwise approved.

(3) Except as provided in Subsection 9F, the width of an exit corridor shall be at least 1,100 mm and the width of other exits at least 900 mm, unless greater widths are required because of the occupant load. In computing the exit width on the basis of occupant load, the minimum aggregate width of exterior exit doors shall be 1 unit [see (6)] per 90 persons, and the minimum aggregate width of other exits not at or near ground level shall be 1 unit per 30 persons. [See also 8C(5)]

(4) Except as provided in Subsection 9 F, the minimum width of a doorway, corridor or passageway in an access to exit shall be 1 unit [see (6)] per 90 persons, but in no case shall the minimum width of a public corridor or in a corridor used by the public be less than 1,100 mm.

(5) Except as provided in Subsection 9 F, the minimum width of a stairway or ramp in an access to exit shall be 1 unit per 60 persons [see (6)].

(6) NBC In determining the width in units of an individual exit, the width of the exit in millimetres shall be divided by 550, and if the remainder is 300 mm or more, it shall be considered as contributing 1/2 unit of exit width.

(7) NBC Except as provided in (8), the required units of exit width shall be cumulative where 2 or more exits converge.

(8) NBC Where an exit stair serves 2 or more floor areas, one above the other, the required units of exit width are not cumulative.

(9) NBC Except as provided in Subsection 9F and in 8C(7) and 8D(8), the minimum height of exits and corridors which provide access to exits shall be 2.1 m.

D. FIRE PROTECTION OF EXITS

(1) This Subsection applies to the fire protection of all exits serving more than 1 dwelling unit.

(2) NBC Except as provided in (4) and (8), every exit other than an exterior doorway shall be separated from the remainder of the building or from another exit by a fire separation having a fire-resistance rating of at least 3/4 h.

(3) NBC A fire separation common to 2 exits shall be smoke-tight and shall not be pierced by doorways, duct work, piping or any other opening that may affect the continuity of the separation.

(4) NBC A fire separation that separates an exit from the remainder of the building shall have no openings except for electrical wiring, noncombustible conduit and noncombustible piping that serve only the exit, and except for standpipe and sprinkler piping and exit doorways.

(5) The area of wired glass in a door or sidelight between an exit enclosure and the remainder of the building shall not exceed 0.8 m^2, except that greater glass areas are permitted when the door or sidelight is located in an enclosed vestibule or corridor constructed as a fire separation having at least a 3/4 h fire-resistance rating.

(6) Openings in the exterior wall of an exit shall be protected with wired glass or glass block installed in accordance with 10M(5) and 10M(8) where openings may be exposed to the hazard of afire in another fire compartment on the same building.

(7) NBC Where an unenclosed exterior exit stair or ramp may be exposed to fire from openings in the exterior walls of the building it serves, the openings in the exterior walls of the building shall be protected with wired glass in fixed steel frames or glass block conforming to 10M(5) and 10M(8) when the openings in the exterior walls of the building are within 3 m horizontally and less than 10 m below or less than 5 m above the exit stair or ramp.

(8) Where an exterior exit door may be exposed to the hazards of a fire from openings in a separate fire compartment located within 3 m horizontally of the exit, such openings shall be protected with wired glass in fixed steel frames conforming to 10M(5) or glass block conforming to 10M(8).

(9) NBC The requirements in (2) do not apply to an exterior exit passageway provided the passageway has at least 50 percent of its exterior sides open to the outdoors and is served by an exit stair at each end of the passageway.

E. OBSTRUCTIONS AND HAZARDS IN MEANS OF EGRESS

(1) This Subsection applies to obstructions and hazards in every means of egress except those within a dwelling unit or serving not more than 1 dwelling unit.

(2) Where a public corridor or a corridor used by the public contains an occupancy, such occupancy shall not reduce the unobstructed width of the corridor to less than the required width of the corridor.

(3) NBC Except as permitted in (4), obstructions located within 1980 mm of the floor shall not project horizontally more than 100 mm into exit passageways, corridors used by the public or public corridors in such a manner that would create a hazard for visually impaired persons travelling adjacent to walls.

NBC

(4) The horizontal projection of an obstruction in (3) is permitted to exceed 100 mm where the obstruction extends to less than 680 mm above the floor. (See 3.3.1.6.(4) in Appendix A, NBC)

(5) Except as permitted in Subsection 9F and 8G(10), no fixture, turnstile or construction shall project within the required width of exit.

(6) No mirror shall be placed in or adjacent to any exit so as to confuse the direction of exit, and no mirror or draperies shall be placed on or over exit doors.

(7) Fuel-fired appliances shall not be installed in an exit or a corridor serving as access to exit.

(7) Service rooms containing equipment subject to possible explosion, such as boilers designed to operate at a pressure in excess of 100 kPa and certain types of refrigerating and transformer equipment, shall not be located under required exits.

F. DOORS IN A MEANS OF EGRESS

(1) This Subsection applies to all doors in a means of egress except exterior doors serving not more than 1 dwelling unit unless otherwise stated herein.

NBC

(2) Exit doors shall not decrease the required exit width by more than 50 mm for each full unit of exit width. [See C(6)]

(3) Doors in their swing shall not reduce the effective width of exit stairs or landings to less than 750 mm, nor shall they reduce the effective width of an exit passageway to less than the required width.

(4) No door closer or other device shall be installed in an exit in such a manner as to reduce the head room clearance to less than 1980 mm.

(5) NBC An exit door or a door that opens to or is located in a public corridor or other facility providing access to exit from suites shall be not less than 2030 mm in height. Except as required by (2) and Subsection 6(C), such doors shall be at least 810 mm in width when only 1 door leaf is installed in an opening, and 610 mm in width where more than 1 door leaf is provided in the width of an opening. The width of an individual door leaf shall not exceed 1220 mm in such openings.

(6) NBC Except as provided in (7) to (10), every door that is located within a corridor that is required to be separated from the remainder of the floor area by a fire separation, and every required exit door shall swing on a vertical axis and open in the direction of exit travel and shall not open onto a step. (See Appendix A).

(7) NBC A door need not conform to (6) where it opens onto a corridor or other facility that provides access to an exit from a room or suite having an occupant load of not more than 60 persons.

(8) NBC A door need not conform to (6) where it is an exit door serving a storage garage which serves not more than 1 dwelling unit, or where it is an exit door serving an accessory building where there is no danger to life safety.

(9) NBC A door serving not more than 1 dwelling unit is permitted to swing inward.

(10) Where there is a possibility of blockage from ice or snow, an exit shall open onto one or more steps. Where more than one dwelling unit is being served, only one step shall be permitted, with a rise of not more than 150 mm. Where a secondary entrance to a single dwelling unit is being served, up to three steps may be permitted [see Article 8D(5)].

(11) Except as permitted in (10), where an exit door opens onto a landing, the landing shall be not less than 300 mm wider and longer than the width of the door. Such doors either in the open or closed position shall be not closer than 300 mm to the nearest riser.

(12) NBC Revolving doors used as exits shall conform to to Article 3.4.8.13 of NBC.

(13) Exit doors and doors to dwelling units shall be openable from the inside without requiring keys, special devices or specialized knowledge of the door opening mechanism.

(14) Except for hotels and motels, a door opening onto a public corridor which provides access to exit from suites shall be designed not to lock automatically when such doors are equipped with automatic self-closing devices. (See Article 3.3.4.3.(6) of the NBC)

(15) Every exit door shall be designed and installed so that when the latch is released the door will open in the direction of exit travel under a force of not more than 90 N applied at the knob or other latch releasing device.

G. ACCESS TO EXITS

(1) This Subsection applies to access to exits within floor areas except within suites unless otherwise stated herein.

(2) NBC Except as permitted in (4) and Subsection I, each suite on a floor area occupied by more than 1 suite shall have an exterior exit doorway or a doorway to a public corridor or to an exterior passageway, and from the point where such doorway enters the public corridor or exterior passageway, it shall be possible to go in opposite directions to each of 2 separate exits.

(3) A dead-end public corridor is acceptable provided it does not exceed 6 m in length, measured from the end of the corridor to the nearest exit. Such dead-ends shall contain no door openings except entrance doors to suites. Such doors shall be located so that it shall not be necessary to pass more than 2 doors in travelling to the nearest exit. The area of wired glass in such doors shall not exceed 645 cm^2.

(4) Except as provided in Subsection I, at least 2 egress doors shall be provided when the area of a suite exceeds 100m^2, or the distance measured from any point within the room or suite to the nearest door opening directly into a public corridor exceeds 15 m. Such doors shall be spaced so that in the event

that one doorway is made inaccessible by fire within such room or suite, the other doorway will provide safe egress.

(5) Required access to exit from suites shall not be through any other dwelling unit, service room or other occupancy.

H. EXITS FROM FLOOR AREAS

(1) NBC Except for (2), for the purposes of this Subsection, travel distance means the distance from any point in the floor area to an exit measured along the path of exit travel.

(2) NBC Where a room or suite is separated from the remainder of the floor area by a fire separation having a fire-resistance rating of at least 3/4 h, the travel distance may be measured from an egress door of the room or suite to the nearest exit.

(3) Except as provided in Subsection I, at least 2 exits shall be provided from every floor area spaced so that the travel distance to the nearest exit shall be not greater than 30 m. Where the floor area is sprinklered and is subdivided into suites, the travel distance may be increased to 45 m. (See (1) for explanation of travel distance.)

(4) Where more than 1 exit is required from a floor area, each exit shall be considered as contributing not more than 1/2 the required units of exit width.

(5) Where more than 1 exit is required from a floor area, at least 2 exits shall be independent of each other and be placed remote from each other along the path of travel between them.

(6) NBC Not more than 1 exit from a floor area above or below the first storey shall lead through a lobby. Such lobby shall be not more than 4.5 m above grade and the path of travel through the lobby to the outdoors shall not exceed 15 m. The lobby shall conform in all respects with the requirements for exits, except that rooms other than service rooms, storage rooms, and rooms of residential occupancy may open directly onto such a lobby. Where the lobby and adjacent occupancies that are permitted to open into the lobby are sprinklered, the fire separation between such occupancies and the lobby need not have a fire-resistance rating. (See A.3.4.5.1.(5)(f) in Appendix A of the NBC)

(7) A mezzanine shall be provided with exits on the same basis as required for a floor area where a mezzanine is considered to be a storey in Subsection 10D, or is of a size required to have more than one exit.

I. EGRESS FROM DWELLING UNITS

(1) Except for a dwelling unit with an egress door opening onto a public corridor or exterior passageway, and except for a dwelling unit having a ground floor area of less than 75 m^2, a dwelling unit shall have at least two exits or egress doors, located on different faces of the building [See also 5L(1)].

(2) Where there is no dwelling unit above another dwelling unit, the travel limit from a floor level in a dwelling unit to an exit or egress door may exceed 1 storey where that floor level is provided with an openable window or ventilation opening providing an unobstructed opening of not less than 1000 mm in height and 550 mm in width, located so that the sill is not more than 1000 mm above the floor and not more than 7 m above adjacent ground level.

(3) Except as provided in (1) and (2), every dwelling unit shall have a sufficient number of exits or egress doors so that it shall not be necessary to travel by a private stairway up or down more than 1 storey to reach a level served by an exit or egress door to a public corridor or exterior passageway.

(4) The travel limit from a floor level in a dwelling unit to an exit or egress door may exceed 1 storey where that floor level has direct access to a balcony.

(5) Except as provided in 9G(3), where an egress door from a dwelling unit opens onto a public corridor or exterior passageway, it shall be possible, from the location where the egress door opens onto the corridor or exterior passageway, to go in opposite directions to 2 separate exits unless the dwelling unit has a second and separate means of egress.

(6) Where an egress door from a dwelling unit opens onto an exit stairway that serves more than 1 dwelling unit, or onto a public corridor served by a single exit stairway, or an exterior balcony served by a single exit stairway, or an exterior passageway served by a single exit stairway, the dwelling unit shall be provided with a second and separate means of egress.

NBC

J. EXIT SIGNS

(1) This Subsection applies to all exits except those serving not more than 1 dwelling unit.

(2) Exits shall be located so as to be clearly visible or their location shall be clearly indicated.

(3) NBC Except for the main entrance door to a building, every exit door in a building 3 storeys in building height, or a building having an occupant load greater than 150, shall have an exit sign over it.

(4) Exit direction signs shall be placed in corridors and passageways where necessary to indicate the direction of exit travel.

(5) NBC Exit signs shall be installed so as to be visible from the exit approach.

(6) NBC Exit signs shall have the word "EXIT" or "SORTIE" in red letters on a contrasting background or white letters on a red background when the sign is internally lighted, and white letters on a red background or red letters on a white background when the sign is externally lighted. Lettering shall be made with at least 19 mm wide strokes and be at least 150 mm high when the signs are externally lighted, and at least 119 mm high if the sign is internally lighted.

(7) Provisions shall be made to illuminate exit signs required in (3) by an electrical circuit separate from other electrical circuits.

(8) NBC In buildings 3 storeys in building height, any part of an exit ramp or stair that continues down to a basement past an exterior exit door shall be clearly marked to indicate that it does not lead to an exit, where there is a possibility that the portion below ground level may be mistaken as the direction of exit travel.

K. LIGHTING

(1) This Subsection applies to the lighting of all exits except those serving not more than 1 dwelling unit.

(2) Every exit and public corridor shall be provided with lighting in accordance with the requirements in 35B(9).

(3) Emergency lighting shall be provided to exits, corridors used by the public and principal routes providing access to exit in an open floor area where such exits, corridors and access routes are below grade, are windowless or are required in buildings in Subsection 10Q to have a fire alarm system.

(4) Emergency lighting required in (3) shall be provided from a source of energy separate from the electrical supply for the building. Such lighting shall be designed to be automatically actuated when the electric lighting in the affected area is interrupted. Illumination from such lighting shall be at least 10 lx for a period of at least 1/2h. Where incandescent lighting is provided, lighting equal to 1 W/m^2 of floor area shall be considered to meet this requirement.

(5) Where self-contained emergency lighting units are used, they shall conform to CSA C22.2 No. 141, "Unit Equipment for Emergency Lighting."

SECTION 10. FIRE PROTECTION

A. SCOPE

For buildings of mixed or non-residential occupancy, the provisions of the NBC shall apply.

B. GENERAL

(1) An assembly required to be of noncombustible construction shall be supported by noncombustible construction.

(2) For the purposes of this Section, roofs with slopes at 60° or more to the horizontal and which are adjacent to a room or space intended for occupancy shall be considered as a wall.

(3) NBC Tents, air-supported structures, Transformer vaults, walkways, elevators and escalators shall conform to Part 3 of the NBC. (See also Section 37.)

(4) Openings through floors that are not protected by shafts or closures shall be protected in conformance with Subsection 3.2.9 of the NBC.

(5) Where fuel-fired appliances are installed on a roof, such appliances shall be installed in conformance with Part 6 of the NBC.

(6) Where sprinklered, standpipe and hose systems or fire alarm and detection systems are installed, they shall be installed to conform to Part 3 of the NBC.

(7) For fire protection measures applying to fuel storage tanks, and the operation of fuel fired appliances, see also Section 34.

(8) Chutes and shafts shall conform to Subsection 3.5.3 of the NBC, except where they are entirely contained within a dwelling unit.

(9) NBC Basements containing more than 1 storey shall conform to the requirements of Part 3 of the NBC.

C. RATINGS

NBC

(1) Where a fire-resistance rating or a fire-protection rating is required in this Section for an element of a building, such rating shall be determined in conformance with Tables 10A and 10B, or in conformance with the test methods described in Part 3 of the NBC.

NBC

TABLE 10A. FIRE AND SOUND RESISTANCE OF WALLS

Type of Wall	No.	Description	Finish on Each Side (1)	Fire-Resistance Rating h	Sound Rating (3)
Solid Brick	1	90 mm thick walls of shale, clay, concrete or sand-lime brick	None	1	II(2)
	2	140 mm thick walls of shale, clay, concrete or sand-lime brick	None	2 1/2	II(2)
	3	190 mm thick walls of shale, clay, concrete or sand-lime brick	None	4	I(2)
Hollow concrete block (normal weight aggregate)	4	90 mm	None	3/4	III
	5	Same as 4	A or B	1 1/2	III
	6	Same as 4	C or D	1 1/2	II
	7	140 mm	None	1	II(2)
	8	Same as 7	A	1 1/2	II
	9	Same as 7	B, C or D	2	II
	10	Same as 7 with mineral fibre between resilient channels on at least 1 side	A	1 1/2	I
	11	190 mm	None	1 1/2	II(2)
	12	Same as 11	A or B	2	I
	13	Same as 11	C or D	3	I

NBC

TABLE 10A. CONT'D

Type of Wall	No.	Description	Finish on Each Side (1)	Fire-Resistance Rating h	Sound Rating (3)
Concrete	14	150 mm	None	3	I(2)
	15	200 mm	None	4	I(2)
Interior wood stud, single row	16	38 mm x 89 mm studs @ 400 mm o.c.	C or D	1	III
	17	38 mm x 89 mm studs @ 400 mm o.c., mineral fibre with a mass of at least 1.2 kg/m^2 in cavity	A	3/4	III
	18	Same as 17 with resilient metal channels on at least 1 side	A	3/4	II
Interior wood stud 2 rows staggered on 38 mm x 140 mm plate	19	Two rows 38 mm x 89 mm studs each set 400 mm or 600 mm o.c. staggered on common 38 mm x 140 mm plate, mineral fibre on each side	C or D	1(4)	II
	20	Two rows 38 mm x 89 mm studs each set 400 mm or 600 mm o.c. staggered on common 38 mm x 140 mm plate, mineral fibre with a mass of at least 1.2 kg/m^2 on each side	A	3/4	II
Interior wood stud 2 rows on separate plates	21	Two rows 38 mm x 89 mm studs each set 400 mm or 600 mm o.c. staggered on 38 mm x 89 mm plates set 25 mm apart, mineral fibre on 1 side	C or D	1(4)	II
	22	Two rows 38 mm x 89 mm studs each set 400 mm or 600 mm o.c. staggered on 38 mm x 89 mm plates set 25 mm apart, mineral fibre with a mass of at least 1.2 kg/m^2 on each side	A	3/4	II

NBC

TABLE 10A. CONT'D

Type of Wall	No.	Description	Finish on Each Side (1)	Fire-Resistance Rating h	Sound Rating (3)
Exterior, wood stud	23	38 mm x 89 mm or 38 mm x 140 mm studs spaced up to 600 mm o.c., mineral fibre with a mass of at least 1.2 kg/m2, wall sheathing and cladding	A (interior side)	3/4	—
	24	Same as 23	C or D (interior side)	1	—
Non load-bearing steel stud	25	90 mm steel studs spaced up to 600 mm o.c.	C	3/4	III
	26	Same as 25	D	1	III
	27	Same as 25 with mineral fibre filling cavity	C	1	II
	28	Same as 25 with mineral fibre filling cavity	D	1[4]	II

NBC

NOTES:

(1) The finishes designated by letter refer to the following:
A = 12.7 mm gypsum board, taped joints
B = 12.7 mm gypsum-sand plaster
C = 15.9 mm special fire-resistant Type X gypsum board conforming to CSA A82.27, "Gypsum Board Products", and
D = 19 mm gypsum-sand plaster on 9.5 mm gypsum lath or metal lath

(2) Sound ratings listed assume that walls have their surfaces sealed by at least 2 coats of paint or other surface finish described in Section 30 to prevent airborne sound leakage.

(3) Rating I signifies constructions with sound transmission class ratings of 50 or more.
Rating II signifies constructions with sound transmission class ratings of 45 to 50.
Rating III signifies constructions with sound transmission class ratings of less than 45.

(4) Mineral fibre is required for sound resistance only and need not be provided to achieve the required fire-resistance rating. Mineral fibre includes fibre processed from rock, slag or glass.

TABLE 10B

NBC

FIRE AND SOUND RESISTANCE OF FLOORS, CEILINGS AND ROOFS (2)					
Type of Assembly	No.	Description	Ceiling Finish (1)	Fire-Resistance Rating h	Sound Rating (3)
Concrete slabs	1	90 mm reinforced concrete with 20 mm minimum cover over reinforcing steel	None	1	II
	2	130 mm reinforced concrete with 25 mm minimum cover over reinforcing steel	None	2	I
Open web steel joists	3	Open web steel joists with minimum 50 mm thick concrete deck, ceiling secured to furring channels spaced not more than 600 mm o.c. wired to underside of joists	C or D	1	I
Wood floor joists	4	19 mm T&G lumber or 15.5 mm plywood or waferboard subfloor with mineral fibre between joists spaced 400 mm o.c., ceiling finish attached to resilient channels	C	3/4	II
	5	Same as 4	D	1	II
	6	19 mm T&G lumber or 15.5 mm plywood or waferboard subfloor over joists spaced 400 mm o.c., 50 mm concrete topping	C	3/4	II
	7	Same as 6	D	1	II
	8	Same as 6 with mineral fibre between joists and ceiling finish attached to resilient channels	C	3/4	II
	9	Same as 6 with mineral fibre between joists and ceiling finish attached to resilient channels	D	1	I

TABLE 10B CONT'D

FIRE AND SOUND RESISTANCE OF FLOORS, CEILINGS AND ROOFS (2)

Type of Assembly	No.	Description	Ceiling Finish (1)	Fire-Resistance Rating h	Sound Rating (3)
Rating provided by membrane only (4)	10	Supporting members spaced not more than 600 mm o.c.	C	1/2	—
	11	Same as 10	C (two layers)	1	—
Wood floor trusses spaced not more than 600 mm oc	12	19 mm T&G lumber or 15 mm plywood or waferboard sub-floor over 38 x 89 mm framing members with metal connector plates at least 1 mm thick with teeth at least 8 mm in length	C	3/4	III
Wood floor trusses spaced not more than 600 mm oc	13	38 mm x 89 mm framing members with connector plates at least 1 mm thick with teeth at least 8 mm in length	C	3/4	—

NBC

NOTES: (1) The finishes designated by letter refer to the following:
C = 15.9 mm special fire-resistant Type X gypsum board conforming to CSA A82.27, "Gypsum Board Products", and
D = 19 mm gypsum-sand plaster on 9.5 mm gypsum lath or metal lath

(2) Fire-resistance ratings for floor assemblies may be applied to roof assemblies having the same ceiling finish, provided that, where wood joists are used, the roof sheathing consists of not less than 12.5 mm plywood or waferboard or 19 mm lumber. Where steel joists are used, the ratings are based on the assumption that the roof deck consists of not less than 50 mm of concrete.

(3) Rating I signifies constructions with sound transmission class ratings of 50 or more.
Rating II signifies constructions with sound transmission class ratings of 45 to 50.
Rating III signifies constructions with sound transmission class ratings of less than 45.

(4) See 10I(14)

(2) Where a flame-spread rating is required in this Section for an element of a building, such rating shall be determined in accordance with the test methods described in Part 3 of the NBC, or in accordance with Chapter 2 of the Supplement to the NBC. Unless such rating is referred to herein as a "surface flame-spread rating," it shall apply to any surface of the element being considered that would be exposed by cutting through it as well as to the exposed surface of the element.

(3) NBC Floor, roof and ceiling assemblies shall be rated for exposure to fire on the underside.

(4) Exterior walls shall be rated for exposure to fire from inside the building. Such walls need not comply with the temperature rise limitations required by the standard tests referred to in (1) if such walls have a limiting distance of at least 1.2m and due allowance is made for the effects of heat radiation in accordance with the requirements in Part 3 of the NBC.

(5) Firewalls and interior vertical fire separations required to have fire-resistance ratings shall be rated for exposure to fire on each side.

(6) Where a ceiling construction has a suspended membrane ceiling with lay-in panels or tiles which contribute to the required fire-resistance rating, hold down clips or other means shall be provided to prevent the lifting of such panels or tiles in the event of a fire.

D. BUILDING SIZE DETERMINATION

(1) NBC Mezzanines shall not be considered as storeys for the purpose of determining building height where the aggregate area of mezzanine floors does not exceed 10 percent of the floor area of the storey in which they are located. (See A-3.2.1.2.(4) in Appendix A, NBC).

(2) NBC Mezzanines shall not be considered as storeys for the purpose of determing building height where they occupy an aggregate area of less than 40 per cent of the floor area of the storey provided the space above the mezzanine floors and the floor below them have no visual obstructions more than 1070 mm above such floors. (See A-3.2.1.2.(4) in Appendix A, NBC).

(3) NBC Where more than 1 tier of mezzanine is provided in a storey, each tier additional to the first shall be considered as a storey. (See Note to Sentence 3.2.1.2(4) in Appendix A of the NBC)

(4) Where a basement is used primarily as a storage garage, the basement may be considered as a separate building for the purpose of this Section, provided the floor above the basement is constructed as a fire separation of reinforced concrete having a fire-resistance rating of at least 2 hours.

(5) NBC Roof-top enclosures provided for elevator machinery, stairways and service rooms, used for no purpose other than for service in the building, shall not be considered as a storey in calculating the building height.

(6) NBC Except as permitted in (8), where portions of a building are completely separated by a vertical fire separation conforming to (7), each separated portion is permitted to be considered as a separate building for the purpose of determing building height, provided each separated portion is not more than 3 storeys in building height and is used only for residential occupancies. The unobstructed path of travel for fire fighters from the nearest street to 1 entrance of each separated portion shall not be more than 45 m (See Appendix A, NBC).

(7) NBC Fire separations in (6) shall have a fire-resistance rating of at least 1 h and shall extend through all storeys and service spaces.

(8) NBC The vertical fire separations in (6) may terminate at the floor assembly immediately above a basement, provided the basement is used primarily as a storage garage and is separated from the remainder of the building in conformance with (4).

E. PERMITTED OPENINGS IN WALL AND CEILING MEMBRANES

(1) Except as permitted in (2) and (3), a membrane forming part of an assembly required to have a fire-resisting rating shall not be pierced by openings into the assembly unless the assembly has been tested and rated for such openings.

(2) A wall or ceiling membrane forming part of an assembly required to have a fire-resistance rating may be pierced by openings for electrical and similar service outlet boxes provided such outlet boxes are tightly fitted. Where such boxes are located on both sides of walls required to provide a fire-resistance rating, they shall be offset where necessary to maintain the integrity of the fire separation.

(3) A membrane ceiling forming part of an assembly required to have a fire-resistance rating may be pierced by openings into noncombustible ducts within the ceiling space provided such openings are located not less than 2 m apart and do not constitute more than 1 per cent of the ceiling area within a fire compartment. Individual openings shall not exceed 900 cm^2 in area, and if greater than 130 cm^2 shall be protected by a fire stop flap as described in M (16).

F. CONSTRUCTION TYPES

(1) Where a wall, floor or roof assembly is required to be of noncombustible construction, combustible elements shall be limited in conformance with the requirements in Article 3.1.4.5 of the NBC.

(2) Heavy timber construction shall be considered to have 3/4 hour fire-resistance rating when it is constructed in accordance with the requirements for heavy timber construction in Part 3 of the NBC.

G. PROTECTION OF STEEL MEMBERS

(1) Except as permitted in (2) to (8), structural steel members used in construction required to have a fire-resistance rating shall be protected to provide the required fire resistance.

(2) Steel lintels in loadbearing walls spanning not more than 2 m and steel lintels in non-loadbearing walls spanning not more than 3 m need not be protected.

(3) The bottom flanges of shelf angles and plates that are not part of the structural frame need not be protected as required in (1).

(4) Steel members around elevator shafts, doorways or supporting elevator and dumbwaiter guides, counterweights and other such equipment when entirely enclosed in a shaft and not forming part of the structural frame of the building, need not be protected.

(5) Steel members for stairways and escalators that are not part of the structural frame of the building need not be protected.

(6) Steel members of porches, balconies, stairways, fire escapes, cornices, marquees and other similar constructions need not be protected provided they are outside of the building.

(7) Steel members not less than 3 m from a property line or a centreline of a public thoroughfare and which are at least 1m away from an unprotected opening need not be protected.

(8) Loadbearing steel or concrete members such as columns, beams and arches at least 3 m from a property line or centreline of a public thoroughfare and which are shielded from a possible fire within the building by construction having a fire-resistance rating at least equivalent to that required for the loadbearing walls, columns and arches in Subsection H need not be protected provided such members are located so that they are not closer to an unprotected opening than the maximum horizontal projection of the member from the wall face.

H. FIRE RESISTANCE IN RELATION TO OCCUPANCY AND HEIGHT

(1) Where a building contains more than 1 major occupancy, the requirements in the NBC shall apply.

(2) Except as otherwise provided in this Subsection, every floor shall have a fire-resistance of at least 3/4 h.

(3) NBC Except as otherwise provided in this Subsection, all loadbearing walls, columns and arches in the storey immediately below a floor or roof assembly shall have a fire-resistance rating not less than that required for the supported floor or roof assembly.

(4) Construction supporting a combustion equipment room need not conform to (3).

(5) NBC Fire-resistance ratings of floors, roofs, load-bearing walls, columns and arches need not conform to this Section if such assemblies conform in all respects to the appropriate requirements in Articles 3.2.2.26 to 3.2.2.50 of the NBC.

(6) NBC Where a portion of a roof supports an occupancy, that portion shall be constructed as a fire separation having a 3/4 h fire resistance rating.

(7) The floor assembly of every exterior passageway used as part of a means of egress shall have a fire-resistance rating of at least 3/4 h or be of non-combustible construction.

(8) NBC Except as provided in (9), no fire-resistance rating is required for floors or mezzanines within a dwelling unit where there is no dwelling unit above another dwelling unit, or above another major occupancy.

(9) NBC Where a crawl space exceeds 1.8 m in height or is used for any occupancy or as a plenum in combustible construction or for the passage of flue pipes, the floor above it shall have a fire-resistance rating of at least 3/4 h.

(10) Basements and cellars containing more than one storey or exceeding 600 m^2 in area shall conform to the requirements contained in Part 3 of the NBC.

I. FIRE SEPARATIONS BETWEEN ROOMS AND SPACES WITHIN BUILDINGS

(1) This Subsection applies to fire separations required between rooms and spaces in buildings except between rooms and spaces within a dwelling unit.

(2) NBC Except as permitted in (3) and (10), a wall or floor assembly required to be a fire separation shall be constructed as a continuous barrier against the spread of fire. (See 3.1.6.1.(1)(a) in Appendix A of the NBC)

(3) Except as permitted in (7) to (10), openings in required fire separations shall be protected with closures conforming to Subsection M.

(4) NBC Except as permitted in (5) to (8), all floor assmeblies shall be constructed as fire separations.

(5) NBC Floor assemblies contained within dwelling units need not be constructed as fire separations.

(6) NBC Floor assemblies for which no fire-resistance rating is required by Subsection H, and floors of mezzanines not required to be counted as storeys in D(1) to D(3) need not be constructed as fire separations.

(7) NBC Interconnected floor spaces shall conform to the requirements of Subsection 3.2.9 NBC.

(8) NBC Where a crawl space is not required by H(9) to be constructed as a basement, the floor above it need not be constructed as a fire separation.

(9) NBC Piping, tubing, ducts, chimneys, wiring, conduit, electrical outlet boxes and any other similar service equipment that penetrate a required fire separation shall be tightly fitted or fire stopped to maintain the integrity of the separation.

(10) Every pipe, duct, electrical conduit, electrical outlet box or other similar service equipment that partly or wholly penetrates a required fire separation shall be noncombustible unless the separation has been tested incorporating such equipment, except that electrical or other similar wiring not exceeding 25 mm in overall diameter or enclosed in a noncombustible conduit, and combustible electrical outlet boxes that have a face area of not more than 160 cm^2 shall be permitted without such tests. Where wires are grouped together, the 25 mm diameter shall apply to the group.

(11) Combustible construction that abuts on or is supported by a noncombustible fire separation shall be constructed so that its collapse under fire conditions will not cause collapse of the fire separation.

(12) NBC Beams and joists framed into masonry or concrete fire separations shall not reduce the thickness of those fire separations to less than 100 mm of masonry or concrete.

(13) Except as provided in (14), a horizontal service space or other concealed space located above a required vertical fire separation shall be divided at the fire separation by an equivalent fire separation within the space.

(14) Where a horizontal service space or other concealed space is located above a required vertical fire separation other than a vertical shaft, such space need not be divided as required in (13) provided the construction between such space and the space below is constructed as a fire separation having a fire-resistance rating at least equivalent to that required for the vertical fire separation, except that where the vertical fire separation is not required to have a fire-resistance rating greater than 3/4 h, the fire-resistance rating of the ceiling may be reduced to 1/2 h.

(15) Except as provided in (16), (17) and (19), suites in residential occupancies shall be separated from adjacent rooms and suites by a fire separation having a fire-resistance rating of at least 3/4 h.

(16) Sleeping rooms in boarding and lodging houses where sleeping accommodation is provided for not more than 8 boarders or lodgers need not be separated from the remainder of the floor area as required in (15) where the sleeping rooms form part of the proprietor's residence and do not contain cooking facilities.

(17) Dwelling units which contain 2 or more storeys including basements shall be separated from adjacent dwelling units and from other parts of the building by a fire separation having a fire-resistance rating of not less than 1 h.

(18) NBC Except as provided in (19) and (20), a storage garage shall be separated from other occupancies by a fire separation having not less than a 1 1/2 h fire-resistance rating.

(19) Except as permitted in (20), storage garages containing 5 cars or fewer shall be separated from other occupancies by a fire separation of not less than 1 h.

(20) Where a storage garage serves only the dwelling unit to which it is attached or built, it shall be considered as part of that dwelling unit, and the fire-resistance rating required in (19) need not be provided for the separation between the garage and the dwelling unit where the construction between the garage and the dwelling unit provides an effective barrier to gas and exhaust fumes, and every door between the garage and dwelling unit conforms to M (19). Where an attic space is common to 2 dwelling units and to the garage, the attic space adjacent to the garage shall be separated from such common attic space by a membrane at least equivalent to Type B, C or D finishes in Table 10A, or the ceiling of the garage shall be protected with a similar membrane.

(21) NBC Except as permitted in (22) to (24), combustible piping shall not be used in any part of a drain, waste or vent system where any part of that system partly or wholly penetrates a fire separation required to have a fire-resistance rating or penetrates a membrane that forms part of an assembly required to have a fire-resistance rating.

(22) NBC Combustible drain, waste and vent piping not located in a vertical shaft is permitted to penetrate a fire separation required to have a fire-resistance rating or a membrane that forms part of an assembly required to have a fire-resistance rating provided the rated assembly incorporating the penetration will resist the passage of flames when subjected to the standard heat exposure criteria in CAN 4-S101, "Standard Methods of Fire Endurance Tests of Building Construction and Materials" at a pressure on the exposed side of at least 50 Pa (gauge) greater than on the unexposed side.

(23) NBC Combustible drain piping is permitted to penetrate a horizontal fire separation provided it leads directly from a noncombustible water closet through a concrete floor slab.

(24) NBC Combustible drain, waste and vent piping is permitted on 1 side of a vertical fire separation provided it is not located in a vertical shaft.

(25) Where a vertical service space contains an exhaust duct that serves more than 1 fire compartment, the duct shall have a fan located at or near the exhaust outlet to ensure that the duct is under negative pressure, and such individual fire compartments shall not have fans that exhaust directly into the duct in the vertical service space.

(26) Public corridors shall be separated from the remainder of the building by a fire separation having at least a 3/4 h fire-resistance rating.

J. COMBUSTION EQUIPMENT ROOMS

(1) This Subsection applies to combustion equipment rooms in all buildings. (See also Subsection 5M and Section 34)

(2) NBC The fire-resistance rating requirements in this Subsection do not apply to the floor assembly immediately below the combustion equipment room.

(3) Except as required in (4) (6) and (9), combustion equipment rooms shall be separated from the remainder of the building by a fire separation having a fire-resistance rating of at least 1h when the floor area containing the combustion equipment room is not sprinklered.

(4) Where, in the opinion of the authority having jurisdiction, a combustion equipment room contains a limited quantity of appliances or equipment and the appliances or equipment do not constitute a fire hazard, the requirements in (3) may be waived (see also 34D).

(5) An incinerator shall not be located in a room with other fuel-fired appliances.

(6) Combustion equipment rooms containing incinerators shall be separated from the remainder of the building by a fire separation having a fire-resistance rating of not less than 2h.

(7) The design, construction, installation and alteration of each indoor incinerator shall conform to NFPA 82, "Incinerators, Waste and Linen Handling Systems and Equipment."

(8) Every incinerator shall be connected to a chimney flue conforming to the requirements in Section 21. Such chimney flue shall serve no other appliance.

(9) Rooms for the temporary storage of garbage, other combustible refuse or for public storage, shall be separated from the remainder of the building by a fire separation having not less than a 1 h fire-resistance rating, except that a 3/4 h fire separation is permitted where the fire-resistance rating of the floor assembly is not required to exceed 3/4 h, or where such rooms are sprinklered.

K. FIREWALLS

(1) Except as provided in (2), a party wall on a property line shall be constructed as a firewall.

(2) In a building in which there is no dwelling unit above another dwelling unit, a party wall on a property line between dwelling units need not be constructed as a firewall provided it is constructed as a fire separation having not less than a 1 h fire-resistance rating. Such wall shall provide continuous protection from the top of such wall and the roof deck shall be tightly sealed by caulking with mineral wool or noncombustible material.

NBC

(3) A required firewall [see B(4) and (1)] shall be constructed as a fire separation on noncombustible construction having a fire-resistance rating of not less than 2h. Except for closures, the required fire-resistance rating of every firewall shall be provided by masonry or concrete.

(4) Except as permitted in (5), where structural framing members are connected to or supported on a firewall, and such members have fire-resistance ratings less than that required for the firewall, the connections and supports for such members shall be designed so that the collapse of the framing members during a fire will not cause the collapse of the firewall.

(5) The requirements in (4) do not apply when a firewall consists of 2 separate wall assemblies each tied to its respective building frame but not to each other provided each wall assembly is constructed as a fire separation having 1/2 the fire-resistance rating required for the firewall in (3), and designed so that the collapse of one wall will not cause the collapse of the other.

(6) Piping and conduit shall be installed so that the collapse of such piping or conduit will not cause the collapse of the firewall.

(7) Except as provided in (8) and (9), every firewall shall extend from the top of the footings continuously through all storeys and not less than 150 mm above the roof surface where the firewall is required to have a 2 h fire-resistance rating. Where a firewall separates 2 buildings with roofs at different elevations, the firewall need not extend above the upper roof surface to form a parapet where the difference in elevation between the 2 roofs so separated is greater than 3 m.

(8) In buildings of noncombustible construction, a firewall need not extend above the roof provided the roof assembly on both sides of the firewall has not less than a 1 h fire-resistance rating where the firewall is required to have a 2 h fire-resistance rating. Such firewall shall terminate at the underside of a solid roof slab or deck with a smoketight joint, and there shall be no concealed spaces within the roof slab in that portion directly above the firewall.

(9) Firewalls located above a basement used primarily as a storage garage that is separated from the remainder of the building by a fire separation as described in Subsection D may terminate at the floor assembly immediately above the storage garage.

(10) Openings in a firewall shall be protected with closures in conformance with Subsection M, and the temperature rise on the unexposed face of such closures shall not exceed 250°C after 1/2 h when a 2 h firewall is required when tested in conformance with the test method described in Part 3 for closures. Wired glass in doors located in 2 h firewalls shall not exceed 645 cm^2 in area.

(11) Openings in firewalls shall conform to Subsection M, except that the aggregate width of all openings shall not exceed 25 per cent of the length of the firewall.

(12) Where the external walls of 2 buildings meet at a firewall at an external angle of 135° or less, the requirements of N(12) shall apply.

L. PREVENTION OF FIRE SPREAD AT EXTERIOR WALLS AND BETWEEN STOREYS

(1) NBC Except as provided in (2), B(3) and I(7), the portions of a floor area or mezzanine that do not terminate at an exterior wall, a firewall or a vertical shaft, shall terminate at a vertical fire separation having a fire-resistance rating at least equal to that required for the floor assembly that terminates at the separation.

(2) NBC A mezzanine need not terminate at a vertical fire separation where the mezzanine is not required to be considered as a storey in D(1) to D(3).

(3) Where a wall in a building is exposed to a fire hazard from an adjoining roof of a separate unsprinklered fire compartment in the same building, the roof shall contain no skylights within a horizontal distance of 5 m of the windows in the exposed wall.

(4) Except as provided in N (12), where exterior walls of a building meet at an external angle of 135° or less, the horizontal distance from an opening in one wall to another opening in the other wall shall be not less than 1.2 m where the openings are in different fire compartments.

(5) Except as provided in (6), where there is a common attic or roof space above more than 2 suites of residential occupancy, and the soffit of a roof overhang adjacent to this space is located over a window, vent closure or door opening within 2.5 m of the overhang, the soffit shall be protected with noncombustible material having a minimum thickness of 0.38 mm and a melting point of at least 650°C, or be protected with not less than 11 mm thick plywood, 12.7 mm thick waferboard or 19 mm thick tongued and grooved lumber. Such protection shall extend the full width of the window, vent closure or door opening and to at least 1.2 m on either side of the opening, with no unprotected opening into the soffit within this limit.

NBC

(6) Where eaves are completely separated from the remainder of the roof space by fire stopping, the requirement for soffit protection in (5) does not apply.

NBC

M. DOORS, DAMPERS AND OTHER CLOSURES IN FIRE SEPARATIONS

(1) Except as provided in (2), openings in required fire separations shall be protected with a closure conforming to Table 10C and shall be installed in conformance with Chapters 2 to 13 of NFPA 80, "Fire Doors and Windows" unless otherwise specified herein. [See also C(1)]

TABLE 10C - FIRE PROTECTION RATINGS FOR CLOSURES

Required Fire-Resistance Rating of Fire Separation, h	Required Fire-Protection Rating of Closure, h
1/2 or 3/4	1/3[1]
1	3/4[1]
1 1/2	1
2	1 1/2
3	2
4	3

Note (1): See 10 M(2) and (3).

(2) A 45 mm thick solid core wood door may be used where a minimum fire-protection rating of 1/3 h is permitted, or between a public corridor and a suite provided that the door conforms to CAN4-S113, "Standard Specification for Wood Core Doors Meeting the Performance Required by CAN4-S104-77 for Twenty Minute Fire-Rated Closure Assemblies". Such doors shall have not more than a 6 mm clearance beneath and not more than 3 mm at the sides and top. (See Appendix A, NBC).

NBC

(3) Doors required to provide a 1/3 h fire-protection rating or permitted to be 45 mm solid core wood shall be mounted in a wood frame of at least 38 mm thickness where the frame has not been tested and rated.

(4) Doors forming part of an exit or a public means of egress shall conform to Subsection 9 F in addition to this Subsection.

(5) Wired glass which has not been tested in accordance with C(1) is permitted as a closure in a vertical fire separation required to have a fire-resistance rating of not more than 1 h provided such glass is not less than 6 mm thick and conforms to 7D(1), and is mounted in conformance with (6).

NBC

(6) Wired glass described in (5) shall be mounted in fixed steel frames having a minimum metal thickness of 1.35 mm and providing a glazing stop of at least 20 mm on each side of the glass. Individual panes of such glass shall not exceed 0.84 m^2 in area or 1400 mm in height or width, and the area of glass not structurally supported by mullions shall not exceed 7.5 m^2.

NBC

(7) Steel door frames forming part of a closure in a fire separation, including anchorage requirements, shall conform to CAN4-S105, "Standard Specification for Fire Door Frames Meeting the Performance Required By CAN4-S104-77."

(8) Glass block that has not been tested in accordance with C (1) is permitted as a closure in a fire separation required to have a fire-resistance rating of not more than 1 h provided each horizontal joint is reinforced with metal.

(9) Closures in fire separations shall not exceed 11 m^2 in area and 3700 mm in height or width.

(10) Every swing type door in a fire separation shall be equipped with a latch.

(11) NBC Except as described in (12), every door in a fire separation shall have an acceptable self-closing device.

(12) NBC Self-closing devices described in (11) are not required in doors between public corridors, other than dead-end corridors.

(13) Where hold-open devices are used on doors in required fire separations, they shall be installed in accordance with Article 3.1.6.7 of the NBC.

(14) For swing-type doors in combustion equipment rooms, see Subsection 5M.

(15) Except as permitted in (17), (18), (19), (20) and E(3), ducts that connect 2 fire compartments or penetrate an assembly required to be a fire separation with a fire rating shall be equipped with a fire damper in conformance with Article 3.1.6.6 of the NBC.

(16) Fire stop flaps in ceiling membranes required in E(3) shall be constructed of not less than 1.47 mm thick sheet steel with 1.59 mm thick asbestos on the unexposed side and be equipped with corrosion-resistant pins and hinges. Such flaps shall be designed to close automatically at a temperature 30°C above the maximum temperature that will normally be encountered in the system.

(17) A fire damper is not required where a noncombustible branch duct pierces a required fire separation provided the duct has a melting point of at least 760°C, a cross-sectional area less than 130 cm^2 and supplies only air-conditioning units or combined air-conditioning and heating units discharging air at not more than 1.2 m above the floor.

(18) A fire damper is not required where a noncombustible branch duct pierces a required fire separation around an exhaust duct riser in which the air flow is upward provided the branch duct has a melting point of at least 760°C, the branch duct is carried up inside the riser at least 500 mm and the exhaust duct is under negative pressure as described in I(25).

(19) Noncombustible ducts that penetrate a fire separation separating a vertical service space from the remainder of the building need not be equipped with a fire damper at the fire separation provided the ducts have a melting point above 760°C and each individual duct exhausts directly to the outdoors at the top of the vertical service space.

(20) A door between an attached or built-in garage and a dwelling shall be tight fitting and weather-stripped to provide an effective barrier against the passage of gas and exhaust fumes and shall be fitted with a self-closing device. A doorway between an attached or built-in garage and a dwelling unit shall not be located in a room intended for sleeping.

(21) Where a 45 mm thick solid core wood door is permitted in a required fire separation, the requirement for a noncombustible sill in NFPA 80, "Fire Doors and Windows" shall not apply.

(22) Where a door is installed so that it may damage the integrity of a fire separation if its swing is unrestricted, door stops shall be installed to prevent such damage.

N. SPATIAL SEPARATIONS BETWEEN BUILDINGS

(1) Except as provided in (2) to (6), the maximum percentage of unprotected openings in an exposing building face shall conform to Table 10D or to Subsection 3.2.3, of the NBC, whichever is the least restrictive. The area of an exposing building face shall be calculated as the total area of exterior wall facing in 1 direction on any side of a building measured from the finished ground level to the uppermost ceiling, except that where a building is divided by fire separations into fire compartments, the area of exposing building face may be calculated for each fire compartment provided such separations have not less than a 3/4 h fire resistance rating.

(2) Where there is no fire department or where a fire department is not, in the opinion of the authority having jurisdiction, organized, trained and equipped to meet the needs of the community, the limiting distance determined from (1) shall be doubled.

(3) The limiting distance shown in Table 10D may be reduced provided it is not less than the square root of the aggregate area of unprotected openings in an exposing building face.

TABLE 10D - MAXIMUM PERCENTAGE OF UNPROTECTED OPENINGS IN EXTERIOR WALLS

Maximum Area of Exposing Building Face m^2	Limiting Distance											
	Less than 1.2m	1.2 m	1.5 m	2.0 m	4.0 m	6.0 m	8.0 m	10.0 m	12.0 m	16.0 m	20.0 m	25.0 m
30	0	7	9	12	39	88	100	—	—	—	—	—
40	0	7	8	11	32	69	100	—	—	—	—	—
50	0	7	8	10	28	57	100	—	—	—	—	—
100	0	7	8	9	18	34	56	84	100	—	—	—
Over 100	0	7	7	8	12	19	28	40	55	92	100	—

(4) The maximum area of unprotected openings may be doubled where the building is sprinklered, or where the unprotected openings are glazed with wired glass in steel frames or glass blocks as described in M(5) and M(8).

(5) An exposing building face is permitted to have unlimited unprotected openings in the first storey when the exposing building face faces a street and has a limiting distance of at least 9 m.

(6) Except as permitted in (7) to (9), each exposing building face and any exterior wall located above an exposing building face that encloses an attic or roof space shall be constructed in conformance with Table 10E and Subsection H.

TABLE 10E - MINIMUM CONSTRUCTION REQUIREMENTS FOR EXPOSING BUILDING FACE

Max. Percentage of Unprotected Openings Permitted, %	Minimum Required Fire Resistance Rating, h	Type of Construction Required	Type of Cladding Required
0 - 10	1	Noncombustible	Noncombustible
11- 25	1	Combustible or Noncombustible	Noncombustible
26- 100	3/4	Combustible or Noncombustible	Combustible or Noncombustible

(7) Except as required in (11), in buildings containing only dwelling units in which there is no dwelling unit above another dwelling unit, the requirements of (6) do not apply provided that the exposing building face has a fire-resistance rating of at least 3/4 h where the limiting distance is less than 1.2 m, and when the limiting distance is less than 0.6 m, the exposing building face is clad with noncombustible material. Window openings in such exposing building face shall not be permitted if the limiting distance is less than 1.2 m, and shall be limited in conformance with the requirements for unprotected openings in (1) where the limiting distance is 1.2 m or greater.

(8) Except as required in (11), the exposing building face of a detached garage that serves only 1 dwelling unit only shall have a fire-resistance rating of at least 3/4 h, except that no fire-resistance rating is required where the limiting distance is 0.6 m or greater. The exterior cladding of such detached garages is not required to be noncombustible regardless of the limiting distance. The percentage of window openings permitted in the exposing building face of such detached garages shall conform to the requirements for unprotected openings in (1). Where a detached garage serves only 1 dwelling unit and is located on the same property as that dwelling unit, then the requirements for limiting distance shall not apply between the garage and the dwelling unit.

(9) NBC Except for buildings containing only 1 or 2 dwelling units, combustible projections on the exterior of a wall that are more than 1 m above ground level, such as balconies, platforms, canopies, eave projections and stairs, that could expose an adjacent building to fire spread, shall not be permitted within 1.2 m of a property line or an imaginary line between 2 buildings on the same property.

(10) Heavy timber and steel columns need not conform to the requirements of Table 10E provided the limiting distance is at least 3 m.

(11) Where a paid or volunteer fire department is not available, the limiting distances required in (7) and (8) shall be doubled.

(12) Where 2 exterior walls meet at a firewall at an external angle of 135° or less, the construction of each exterior wall adjacent to the intersection and the unprotected openings in each exterior wall adjacent to the intersection shall conform to Article 3.2.3.10 of the NBC.

O. FIRE STOPS

(1) NBC Concealed spaces in interior walls, ceiling and crawl spaces shall be separated by fire stops from concealed spaces in exterior walls and attic or roof spaces.

(2) NBC Except as permitted in (3) and (4), fire stops shall be provided to block off concealed spaces within wall assemblies, including spaces created by furring, at each floor level, and at each ceiling level where the ceiling contributes to part of the required fire resistance rating, and at other locations within the wall, so that the distance between fire stops does not exceed 20 m horizontally and 3 m vertically.

(3) NBC Fire stops in (2) are not required provided the exposed construction materials within the wall space, including insulation, except for wiring, piping or similar services, have a flame-spread rating of not more than 25.

(4) NBC Fire stops in (2) are not required provided the wall space is filled with insulation.

(5) NBC Fire stops shall be provided at all interconnections between concealed vertical and horizontal spaces in interior coved ceilings, drop ceilings and soffits, where the exposed construction materials within the confined space have a flame spread rating greater than 25.

(6) NBC Fire stops shall be provided at the top and bottom of each run of stairs where they pass through a floor containing concealed space in which the exposed construction materials have a flame spread rating greater than 25.

(7) In unsprinklered buildings of combustible construction, every concealed space created by a ceiling, roof space or unoccupied attic space shall be separated by fire stops into compartments of not more than 300 m^2 in areas where such space contains exposed construction materials having a flame-spread rating greater than 25. No dimension of such space shall exceed 20 m.

NBC

(8) Concealed spaces in mansard or gambrel style roofs, exterior cornices, balconies and canopies of combustible construction in which the exposed construction materials within the space have a flame-spread rating exceeding 25 shall have vertical fire stops at intervals of not more than 20 m and at points where such concealed spaces extend across the ends of required fire separations.

NBC

(9) Fire stops shall be constructed of not less than 0.38 mm sheet steel, 6 mm asbestos board, 12.7 mm gypsum wallboard, 12 mm plywood or waferboard, with joints having continuous support, 2 layers of 19 mm lumber with joints staggered, 38 mm lumber or materials conforming to Article 3.1.9.4.(1) of the NBC.

NBC

(10) Where fire stops are pierced by pipes, ducts or other elements, the effectiveness of the fire stops shall be maintained around such elements.

P. FLAME-SPREAD LIMITS

(1) Except for doors and except as otherwise provided in this Subsection, the exposed surface of every wall and ceiling, including skylights and glazing, shall have a surface flame-spread rating of not more than 150.

NBC

(2) Not less than 90 per cent of the exposed surface of every ceiling in an exit or unsprinklered ceiling in a public corridor shall have a surface flame-spread rating of not more than 25. [see also (6)]

(3) Except as provided in (4), not less than 90 per cent of the exposed surfaces of every wall of an exit, exclusive of doors, shall have a surface flame-spread rating of not more than 25. [see(6)]

NBC

(4) NBC At least 75 per cent of the wall surface of a lobby at or near grade used as an exit in 9H(7) shall have a surface flame-spread rating of not more than 25. [see (6)]

(5) NBC At least 90 per cent of the total wall surface in any unsprinklered public corridor shall have a surface flame-spread rating of not more than 75, or not less than 90 per cent of the upper half of such walls shall have a surface flame-spread rating of not more than 25. [see (6)]

(6) NBC Combustible doors, skylights, glazing, and combustible light diffusers and lenses shall not be considered in the calculation of wall and ceiling areas in this Subsection.

(7) Where a public corridor or a corridor used by the public contains an occupancy, the interior finish materials used on the walls or ceiling of such occupancy shall have a flame-spread rating in conformance with that required for public corridors.

(8) NBC Where lighting elements such as light diffusers and lenses have flame-spread ratings that exceed those permitted for the ceiling finish, such elements shall conform to the requirements of Subsection 3.1.11 of the NBC.

(9) NBC Individual combustible skylights in corridors required to be separated from the remainder of the building by fire separations shall not exceed 1 m^2 in area and shall be spaced at least 1.2 m apart.

(10) NBC Where foamed plastic is used in an assembly permitted to be of combustible construction, it shall be protected on the interior surfaces by 1 of the finishes described in Subsections 30D to 30L.

(11) NBC In an assembly required to be of noncombustible construction, foamed plastics shall be protected in conformance with Article 3.1.4.5 of the NBC.

(12) Where a covering or a lining is used with a duct, such lining or covering shall have a flame-spread rating conforming to Part 6 of the NBC.

(13) NBC Where an exterior exit passageway provides the only means of egress from the rooms or suites it serves, the wall and ceiling finishes of that passageway, including the soffit beneath and the guard on the passageway, shall have a flame-spread rating of not more than 25, except that up to 10 per cent of the total wall area and 10 per cent of the total ceiling area is permitted to have a flame-spread rating of not more than 150.

Q. ALARM AND DETECTION SYSTEMS

(1) NBC Where access is provided through a firewall, the requirements in this Subsection shall apply to the floor areas on both sides of the firewall as if they were in the same building.

(2) NBC Except as provided in (3), a fire alarm system shall be installed in every building that provides sleeping accommodation for more than 10 persons, or contains more than 3 storeys, including storeys below the first storey. (For mixed occupancies, see 9.10.17.2, NBC)

(3) NBC A fire alarm system is not required in a residential occupancy where an exit or public corridor serves not more than 4 suites, or where each suite has direct access to an exterior exit facility leading to ground level.

(4) Where a fire alarm system is required, every public corridor in buildings of residential occupancy and every exit stair shaft shall be provided with smoke detectors.

(5) NBC Except as provided in (7), buildings required to have a fire alarm system shall be equipped with heat detectors or smoke detectors in storage rooms, combustion equipment rooms, elevator shafts, chutes, janitors' closets and any other rooms where hazardous substances are intended to be used or stored.

(6) Except as provided in (7), a heat detector shall be installed in every combustion equipment room and shall be connected to an audible alarm.

(7) Heat detectors and smoke detectors described in (5) and (6) are not required in a dwelling unit or in sprinklered buildings in which the sprinkler system is electrically supervised and equipped with a water flow alarm.

(8) Except for a recirculating air system serving not more than 1 dwelling unit, where a fire alarm system is required to be installed, every recirculating air handling system shall be designed to prevent the circulation of smoke upon a signal from a duct-type smoke detector where such system supplies more than 1 suite on the same floor or serves more than 1 storey.

(9) Except as provided in (10), where a vertical fire separation having a fire-resistance rating of at least 1 h separates a portion of a building from the remainder of the building and there are no openings through the fire separation other than those for piping, tubing, wiring and conduit, the requirements for fire alarm and detection systems may be applied to each portion so separated as if it were a separate building.

(10) The provisions of (9) do not apply to service rooms and storage rooms.

(11) Fire alarm, fire detection and smoke detection devices and their installation shall conform to Part 3 of the NBC.

R. SMOKE ALARMS

(1) Smoke alarms shall conform to ULC-S531, "Standard for Smoke Alarms".

(2) Smoke alarms shall be installed in each zone of a dwelling unit containing bedrooms or sleeping areas, and where the sleeping zone is served by a hallway, the smoke alarm shall be located in the hallway.

(3) Smoke alarms in (1) and (2) shall be installed on or near the ceiling.

(4) Except as provided in (5), smoke alarms shall be installed by permanent connections to the electrical circuit serving the switched light or outlet and shall have no disconnect switch between the overcurrent device and the smoke alarm.

(5) Where the building is not supplied with electrical power, smoke alarms may be battery operated.

(6) Where more than 1 smoke alarm is required in a dwelling unit, the smoke alarms shall be wired so that the activation of 1 alarm will cause all alarms within the dwelling unit to sound.

(7) Where instructions are neccessary to describe the maintenance and care required for smoke alarms to ensure continuing satisfactory performance, they shall be posted in a location where they will be readily available to the occupants for reference.

S. FIRE FIGHTING

(1) Except as provided in (2), a window or access panel providing an opening not less than 1100 mm high and 550 mm wide and having a sill height of not more than 900 mm above the floor shall be provided on the second and third storey of every building in at least 1 wall facing on a street if such storeys are not sprinklered. Such access panels shall be readily openable from both inside and outside or be glazed with plain glass.

(2) Access panels as described in (1) need not be provided in buildings containing only dwelling units where there is no dwelling unit above another dwelling unit.

(3) Except in basements serving not more than 1 dwelling unit, each sprinklered basement or cellar exceeding 25 m in length or width shall be provided with direct access to the outdoors to at least 1 street. Such access may be provided by a door, window or other means that provide an opening not less than 1,100 mm high and 550 mm wide, the sill height of which shall not be more than 900 mm above the floor. Access may also be provided by an interior stair accessible from the outdoors.

(4) Access for fire department equipment shall be provided to each building by means of a street, private roadway or yard.

(5) Where access to a building as required in (4) is provided by means of a private roadway or yard, the design and location of such roadway or yard shall be acceptable, taking into account connection with public thoroughfares, weight of firefighting equipment, width of roadway, radius of curves, overhead clearance, location of fire hydrants, location of fire department connections and vehicular parking.

(6) Every dwelling unit shall be equipped with at least two field rechargable portable fire extinguishers, type ABC, each having a minimum capacity of 2 kg. Both extinguishers shall be mounted at eye level, one adjacent to the combustion equipment room entrance, and the other adjacent to the kitchen entrance.

SECTION 11. SOUND CONTROL

A. SOUND TRANSMISSION CLASS RATING (AIRBORNE SOUND)

NBC

Sound transmission class ratings for construction shall be determined in accordance with ASTM E90, "Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions" or with ASTM E336, "Measurement of Airborne Sound Insulation in Buildings". (See Appendix A, NBC)

B. REQUIRED SOUND CONTROL LOCATIONS (AIRBORNE SOUND)

(1) Except as provided in (2), every dwelling unit shall be separated from every other space in a building in which noise may be generated by construction providing a sound transmission class rating of at least 45, or shall have a sound rating of I or II as described in Tables 10A and 10B.

(2) Where a dwelling unit is adjacent to an elevator shaft or a refuse chute, the separating construction shall have a sound transmission class rating of at least 50, or shall have a sound rating of I as described in Table 10A.

(3) Building services located in an assembly required to have a sound transmission class rating shall be installed in a manner that will not decresae the required rating of the assembly.

SECTION 12. EXCAVATION

A. GENERAL

(1) In non-permafrost areas, the top soil and vegetable matter in all unexcavated areas under a building shall be removed.

(2) In permafrost areas, the natural ground cover and trees over a construction area shall not be removed without permission of the authority having jurisdiction.

(3) The bottom of every excavation shall be free of all organic material.

(4) Excavations shall be kept free of standing water.

(5) Except in permafrost areas, the bottom of excavations shall be kept from freezing throughout the entire construction period.

(6) In permafrost areas, the bottom of excavations shall be protected from thawing during the entire construction period.

B. DEPTH

(1) Excavations for foundations shall extend to undisturbed soil.

(2) Except as provided in (4) and (5), the minimum depth of foundations below finished ground level in non-permafrost soils shall conform to Table 12A.

(3) The minimum depth of foundations for exterior concrete steps with more than 2 risers shall conform to (2). Concrete steps with 1 and 2 risers may be laid on ground level.

(4) The foundation depths required in (2) may be decreased where experience with local soil conditions shows that lesser depths are satisfactory, or where the foundation is designed for lesser depths.

TABLE 12A

MINIMUM DEPTHS OF FOUNDATIONS IN NON-PERMAFROST SOILS(1)

Type of Soil(2)	Foundation Containing Heated Basement, Cellar or Crawl Space		Foundation Containing No Heated Space	
	Good Soil Drainage to at Least the Depth of Frost Penetration	Poor Soil Drainage	Good Soil Drainage to at least the Depth of Frost Penetration	Poor soil Drainage
Rock	No limit	No Limit	No limit	No limit
Coarse grained soils	No limit	No limit	No limit	Below the depth of frost penetration
Silt	No Limit	No Limit	Below the depth of frost penetration	Below the depth of frost penetration
Clay or soils not clearly defined	1.2 m	1.2m	1.2 m but not less than the depth of frost penetration	1.2 m but not less than the depth of frost penetration
Column 1	2	3	4	5

Notes to Table 12A:
(1) For foundations in permafrost, see Section 15
(2) See Appendix A.

(5) The foundation depths required in (2) do not apply to foundation for buildings whose superstructure will not be damaged by differential soil movement caused by frost action, or for accessory buildings of not more than 1 storey in building height and not more than 50 m^2 in building area.

C. BACKFILL

(1) Backfill shall be placed to avoid damaging the drainage tile or the waterproofing of walls. A slip sheet of 0.15 mm polyethylene or other suitable material shall be placed over all parts of foundation wall insulation that is in contact with the ground, to prevent adfreezing damage.

(2) Backfill shall be graded to prevent drainage towards the foundation after settling.

(3) Backfill within 600 mm of the foundation shall be free of deleterious debris and boulders larger than 250 mm diam.

D. TRENCHES BENEATH FOOTINGS

The soil in trenches dug for sewers and watermains beneath footings shall be compacted by tamping up to the level of the footing base or shall be filled with concrete having a strength not less than 10 MPa to support the footing.

SECTION 13. WATERPROOFING AND DAMPPROOFING

A. GENERAL

(1) This Section applies to all buildings regardless of size.

(2) Where hydrostatic pressure occurs, floors on ground and exterior surfaces of walls below ground level shall be waterproofed.

(3) Unless it can be shown to be unnecesssry, slabs on ground in other than garages shall be dampproofed.

(4) Roofs of underground structures shall be waterproofed to prevent the entry of water into the structure.

(5) The method of application of all bituminous waterproofing and dampproofing materials shall conform to one of the following:

CGSB 37-GP, "Application of Emulsified Asphalts for Dampproofing or Waterproofing."

CGSB 37-GP-12M, "Application of Unfilled Cutback Asphalt for Dampproofing," or

CGSB 37-GP-22M, "Application of Unfilled Cutback Tar Foundation Coating for Dampproofing."

B. MATERIAL

Bituminous materials used for dampproofing or waterproofing shall conform to one of the following:

CGSB 37-GP-2M, "Asphalt, Emulsified, Mineral Colloid Type, Unfilled, or Dampproofing and Waterproofing, and for Roof Coatings,"

CGSB 37-GP-6M, "Asphalt, Cutback, Unfilled, for Dampproofing."

CGSB 37-GP-16M, "Asphalt, Cutback, Filled, for Dampproofing and Waterproofing,"

CGSB 37 -GP-18M, Tar, Cutback, Unfilled, for Dampproofing," or

CSA A123.7, Asphalt for Use in Constructing Built-Up Roof coverings and Dampproofing and Waterproofing Systems."

C. WATERPROOFING OF WALLS

(1) Unit masonry walls to be waterproofed shall be parged on exterior surfaces below ground level with not less than 6 mm of mortar conforming to Section 20. Concrete walls shall have all holes and recesses resutling from removal of form ties sealed with mortar or waterproofing material.

(2) Concrete or unit masonry walls to be waterproofed shall be covered with not less than 2 layers of bitumen-saturated membrane, with each layer being cemented in place with bitumen and coated over-all with a heavy coating of bitumen.

D. WATERPROOFING OF FLOORS

Basement floors to be waterproofed shall have a system of membrane waterproofing provided between 2 layers of concrete each of which shall be not less than 75 mm thick. The floor membrane shall be mopped to the wall membrane to form a complete seal.

E. DAMPPROOFING OF WALLS

(1) Unit masonry walls to be dampproofed shall be parged on the exterior face below ground level with not less than 6mm of mortar conforming to Section 20 and shall be coved over the footing when the first course of block is laid. Concrete walls shall have any holes and recesses resulting from the removal of form ties sealed with cement mortar or dampproofing material.

(2) A heavy coat of bituminous or other dampproofing material shall be applied over the parging or concrete below ground level.

(3) Where a separate interior cladding is applied to a concrete or unit masonry wall which is in contact with the soil, or where wood members are applied to such walls for the installation of insulation or finish, the interior surface of the foundation wall below ground level shall be dampproofed. The dampproofing shall extend from the basement floor and shall terminate at ground level. No membrane shall be applied above ground level between the insulation and the foundation wall. Dampproofing shall consist of at least 0.05 mm polyethylene lapped 100 mm at the joints, or a material providing equivalent performance.

F. DAMPPROOFING OF SLABS

(1) When slabs are damprpoofed, the dampproofing shall be installed below the slab, except that where a separate floor is provided over the slab, the dampproofing may be applied to the top of the slab.

(2) NBC When installed below the slab, dampproofing shall consist of 0.15 mm polyethylene. Dampproofing shall be lapped not less than 100 mm at the joints.

(3) When installed above the slab, dampproofing shall consist of at least 2 mopped-on coats of bitumen, 0.05 mm polyethelene or other material providing equivalent performance.

SECTION 14. DRAINAGE

A. SCOPE

(1) This Section applies to subsurface drainage and to surface drainage for all buildings, regardless of size.

(2) Drainage for crawl spaces shall conform to Section 18.

(3) Drainage requirements beneath floor slabs shall conform to Section 16.

B. GENERAL

Unless it can be shown to be unnecessary, the bottom of every exterior foundation wall shall be drained by drainage tile or pipe laid around the exterior of the foundation in conformance with Subsection C or by a layer of gravel or crushed rock in conformance with Subsection D.

C. DRAINAGE TILE AND PIPE

(1) Drain tile and drain pipe used for foundation drainage shall conform to the following:

CAN 3-G401 "Corrugated Steel Pipe Products".
ASTM C4-62, "Clay Drain Tile",
ASTM C700, "Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated",
ASTM C412, "Concrete Drain Tile",
ASTM C444, "Perforated Concrete Pipe",
CGSB 34-GP-22M, "Pipes, Asbestos Cement, Drain",
CGSB 41-GP-29M, "Tubing,Drainage,Corrugated,Plastic", or
CSA B182.1, "Plastic Drain and Sewer Pipe and Pipe Fittings".

(2) Drain tile or pipe used for foundation drainage shall have a diameter of at least 100 mm.

(3) Drain tile or pipe shall be laid on undisturbed or well-compacted soil so that the top of the tile or pipe is below the bottom of the floor slab or crawl space.

(4) Drain tile or pipe with butt joints shall be laid with 6 mm to 10 mm open joints. The top half of such joints shall be covered with sheathing membrane, 0.10 mm polyethylene or No. 15 asphalt or tar-saturated felt.

(5) The top and sides of drain tile or pipe shall be covered with not less than 150 mm of crushed stone or other coarse clean granular material containing not more than 10 percent of material that will pass a 4 mm sieve.

D. GRANULAR DRAINAGE LAYER

(1) Granular material used to drain the bottom of a foundation shall consist of a continuous layer of crushed stone or other coarse clean granular material containing not more than 10 percent of material that will pass through a 4 mm sieve.

(2) Granular material in (1) shall be laid on undisturbed or compacted soil to a minimum depth of at least 125 mm beneath the building and extend at least 300 mm beyond the outside edge of the footings.

(3) The bottom of an excavation drained by a granular layer shall be graded so that the entire area described in (2) is drained to a sump conforming to E(2).

(4) Where because of wet site conditions soil becomes mixed with the granular drainage material, sufficient additional granular material shall be provided so that the top 125 mm are kept free of soil.

E. DRAINAGE DISPOSAL

(1) Drain tile or pipe shall drain to a sewer, drainage ditch or dry well.

(2) Where a sump pit is provided, it shall be at least 750 mm in depth and have an area of at least 0.25 m^2 and be provided with a cover. Where gravity drainage is not practical, an automatic sump pump shall be provided to drain the water into a sewer, drainage ditch or dry well.

(3) Dry wells may only be used when located in areas where the groundwater level is below the bottom of the dry well. Dry wells shall not be less than 5 m from the building foundation and located so that the drainage is away from the building.

F. SURFACE DRAINAGE

(1) The building shall be located or the building site graded so that water will not accumulate at or near the building.

(2) In areas subject to permafrost, low areas adjacent to the building shall be graded to ensure drainage away from the building or foundation pad. Grading for drainage shall be by fill only.

(3) The soil under granular pads in permafrost areas shall not be disturbed,except to cut channels to ensure drainage.

(4) Surface drainage shall be directed away from the location of a water supply well or septic tank disposal bed.

(5) Where runoff water from a driveway is likely to accumulate or enter a garage, a catch basin shall be installed to provide adequate drainage.

(6) Where downspouts are provided and are not connected to a sewer, provisions shall be made to prevent soil erosion.

(7) Adequate surface water drainage shall be provided over the entire building site.

(8) Where the grading will result in the collection of surface water on the site, catch basins to carry such surface water from the site shall be installed, or other acceptable methods of drainage used to dispose of surface water without soil erosion.

(9) Driveways, walks, terraces, retaining walls or other construction shall not be constructed to interfere with the flow of surface drainage.

SECTION 15: FOOTINGS AND FOUNDATIONS

A. SCOPE

(1) NBC Except as provided in (3) and (4), this Section applies to concrete or unit masonry foundation walls and concrete footings on soils with an allowable bearing pressure of 75 kN/m^2 or greater, for buildings of wood frame or masonry construction.

(2) NBC Foundations for applications other than as described in (1) shall be designed in accordance with Subsection 4D.

(3) Where the permafrost condition of the supporting soil or rock is such that the material is unstable upon thawing, the foundation shall be designed in accordance with the appropriate requirements of the National Building Code of Canada.

(4) Buildings with unusual thermal or structural loading conditions shall have foundations designed in accordance with the appropriate requirements of Part 4 of the National Building Code of Canada by a designer competent in this field.

B. GENERAL

(1) Where soil that is susceptible to frost action supports a foundation that is not located below the depth of frost penetration, insulation shall be located so that heat from the building is permitted to reach the ground beneath the perimeter of the foundation. (See Section 26)

(2) Foundations erected on permafrost shall be designed to maintain the permafrost in a frozen condition at and below the load carrying level, unless it can be shown that the design and the construction procedure are such that thawing of the permafrost will not result in settlement that will be detrimental to the building.

(3) Where permafrost is required to be maintained beneath a foundation, use shall be made of a pad of granular material as described in C(3) and C(4), a ventilated foundation space or insulation installed between the underside of the building and the ground surface or by a combination of these. Where a vented foundation space is included to protect the permafrost, it shall provide at least 300 mm clear height under the entire building to ensure free air movement beneath the building to minimize heat transfer from the building to the permafrost. [See also 18 D(1)]

(4) Buildings with basements or cellars shall be permitted only where the design is such that differential settlement will not develop due to thawing of permafrost.

(5) Measures shall be taken to protect the permafrost over the entire area required during construction activity, either by undertaking construction during the cold season, or by taking adequate protective measures.

(6) NBC Foundations of wood frame construction are permitted to be used provided they conform to (7) or (8).

(7) NBC Except as provided in (8), wood frame foundations shall be designed in conformance with Part 4 of the NBC.

(8) NBC Wood frame foundations need not conform to (7) provided such foundations, including their lateral supports, conform to CSA S406, "Construction of Preserved Wood Foundations" and are not used for the support of masonry or concrete walls. The foundation shall be supported on soil having an allowable bearing pressure of at least 75 kN/m^2 and shall not be subjected to loads that exceed those determined from the design assumptions listed in Clause 1.1.2 of the Standard.

(9) Where pier type foundations are used, the piers shall be designed to support the applied loads from the superstructure.

(10) Where piers are used as a foundation system in a building of 1 storey in building height, the piers shall be installed to support the principal framing members, and shall be spaced not more than 3.5 m apart along the framing, unless the piers

and their footings are designed for larger spacings. The height of such piers shall not exceed 3 times their least dimension at the base of the pier. Where concrete block piers are used, they shall be laid with cores placed vertically, and when the width of the building is 4.3 m or less, placed with their longest dimension at right angles to the longest dimension of the building.

(11) NBC Concrete shall conform to Section 3.

(12) Concrete block shall be loadbearing type conforming to CSA A165.1, "Concrete Masonry Units," and shall have a compressive strength over the gross area of the block of at least 7.5 MPa for hollow units and 12.5 MPa for solid units.

(13) Mortar, mortar joints, corbelling and protection for unit masonry shall conform to Section 20.

C. FOOTINGS

(1) Footings shall be provided under walls, pilasters, columns, piers, fireplaces and chimneys that bear on soil or rock, except that footings may be omitted under piers or monolithic concrete walls if the safe loadbearing capacity of the soil or rock is not exceeded.

(2) Footings shall rest on undisturbed soil, rock or compacted granular fill.

(3) Surface foundations in permafrost areas shall be placed on pads of coarse granular fill having a maximum particle size of 75 mm, and containing not more than 10 percent of material that will pass a 4 mm sieve, and shall be at least 600 mm above existing ground level, except that for buildings over 150 m^2 in building area, the fill shall be at least 1 m above ground level.

(4) Raised pads designed to protect permafrost, as described in (3), shall be placed in compacted layers not exceeding 150 mm in thickness. The pad shall extend horizontally at least 1.5 m beyond the perimeter of the house and the outer edge of all footing pads. The slope at the edge of raised pads shall not be greater than 1:4 unless protected from erosion. In no case shall the slope exceed 1:2.

(5) Maximum allowable bearing pressure on pads of coarse granular fill is 50 kN/m^2, unless specifically designed for greater pressures.

(6) Except as provided in (5) to (11), the minimum footing size shall be shown in Table 15A provided the length of supported joists does not exceed 4.9 m and the design live load on any floor supported by the footing does not exceed 2.4 kN/m^2. Where the design live load exceeds 2.4 kN/m^2, or the length of the supported joists exceeds 4.9 m, footings shall be designed in accordance with Section 4.2 of the NBC.

NBC

(7) Where a foundation rests on gravel, sand or silt in which the water table level is less than the width of the footings below the bearing surface, or where the footings rest on a raised pad of granular material designed to protect permafrost, the footing width shall not be less than twice the width shown in Table 15A.

TABLE 15A - MINIMUM FOOTING SIZES

No. of Floors Supported	Minimum Widths of Strip Footings, mm		Minimum Footing Area for Columns Spaced 3 m o.c.[1], m^2
	Supporting Exterior Walls	Supporting Interior Walls	
1	250[2]	200[3]	0.4
2	350[2]	350[3]	0.75
3	450[2]	500[3]	1.0

Notes to Table 15A:
(1) See 15C(11)
(2) See 15C(8) and (9)
(3) See 15C(10)

(8) The strip footing sizes for exterior walls shown in Column 2 of Table 15A shall be increased by 65 mm for each storey of masonry veneer over wood frame construction supported by the foundation wall.

(9) The strip footing sizes for exterior walls shown in Column 2 of Table 15A shall be increased by 130 mm for each storey of masonry construction supported by the foundation wall.

(10) The minimum strip footing sizes for interior walls shown in Column 3 of Table 15A shall be increased by 100 mm for each storey of masonry construction supported by the footing.

(11) The footing area for column spacings other than shown in Table 15A shall be adjusted in proportion to the distance between columns.

(12) NBC Footings for interior non-loadbearing masonry walls shall be at least 200 mm wide for partitions up to 5.5 m high and shall be increased by 100 mm for each additional 2.7 m of height.

(13) Footings shall be at least 100 mm in thickness except when greater thicknesses are required because of the projection of the footing beyond the supported element.

(14) The projection of an unreinforced footing beyond the supported element shall be not greater than the thickness of the footing.

(15) NBC Where step footings are used, the vertical rise between horizontal portions shall not exceed 600 mm and the horizontal distance between risers shall not be less than 600 mm.

(16) In permafrost areas, every buried foundation shall be embedded in permafrost a sufficient depth to ensure firm anchorage or shall be otherwise protected from possible damage by frost action. Where embedment of the foundation in permafrost is required to resist frost action, the foundations shall not be loaded until sufficient adfreezing has occurred to develop adequate anchorage against frost heaving and sufficient strength to support the design load.

(17) In permafrost areas, the minimum cross-sectional area of wood exposed to soil shall be 89 mm by 89 mm.

(18) In permafrost areas, untreated timber may be used for surface foundations as described in Subsection 15C, providing the timber is exposed to free circulation of air.

D. FOUNDATION WALLS

(1) Where average stable soils are encountered, the thickness of foundation walls subject to lateral earth pressure shall conform to Table 15B for walls not exceeding 2.5 m in unsupported height.

TABLE 15B - THICKNESS OF FOUNDATION WALLS

Type of Foundation Wall	Minimum Wall Thickness, mm	Maximum Height of Finish Grade Above Basement Floor or Inside Grade	
		Foundation Wall Laterally Unsupported at the Top,[1] m	Foundation Wall Laterally Supported at the Top,[1] m
Solid Concrete (14 MPa minimum strength)	150 200 250 300	0.76 1.22 1.37 1.52	1.52 2.13 2.29 2.29
Solid Concrete (20 MPa minimum strength)	150 200 250 300	0.76 1.22 1.37 1.52	1.83 2.29 2.29 2.29
Unit Masonry	140 190 240 290	0.61 0.91 1.22 1.37	0.61 1.22 1.83 2.13

Note to Table 15B: See 15D(2)

(2) For the purposes of (1), foundation walls shall be considered laterally supported at the top if such walls support solid masonry superstructure, or if the floor joists are embedded in the top of the foundation walls. Foundation walls shall also be considered to be supported at the top if the floor system is anchored to the top of the foundation walls with anchor bolts, in which case the joists may run either parallel or perpendicular to the foundation wall. When a foundation wall contains an opening more than 1.2 m in length or contains openings in more than 25 per cent of its length, that portion of the wall beneath such openings shall be considered laterally unsupported, unless the wall around the opening is reinforced to withstand the earth pressure. When the length of solid wall between windows is less than the average length of the windows, the combined length of such windows shall be considered as a single opening.

(3) Exterior foundation walls shall extend not less than 150 mm above finished ground level.

(4) Where the top of a foundation wall is reduced in thickness to permit the installation of floor joists, the reduced section shall be not higher than 350 mm and not less than 90 mm thick.

(5) Where the top of a foundation wall is reduced in thickness to permit the installation of a masonry exterior facing, the reduced section shall be not less than 90 mm thick and tied to the facing material with metal ties conforming to 20 I(5) spaced not more than 200 mm o.c. vertically and 900 mm o.c. horizontally. The space between wall and facing shall be filled with mortar.

(6) Corbelling of foundation walls supporting cavity walls shall conform to 20 L(2).

(7) Crack control joints shall be provided in foundation walls exceeding 25 m in length at intervals of not more than 15 m. Such joints shall be designed to resist moisture penetration, and shall be keyed to prevent relative displacement of the wall portions adjacent to the joint.

(8) Interior masonry foundation walls not subject to lateral earth pressure shall conform to Section 20.

E. JOIST AND BEAM SUPPORT

(1) Foundation walls of hollow unit masonry supporting floor joists shall be capped with at least 50 mm of solid masonry or concrete or have the top course filled with mortar or concrete, except that such capping may be omitted when the joists are supported on a wood plate not less than 38 mm by 89 mm where the siding overlaps the foundation wall not less than 12 mm.

(2) Not less than a 190 mm depth of solid masonry shall be provided beneath beams supported on masonry. Where the beam is supported below the top of the foundation walls, the ends of such beams shall be protected from the weather.

(3) Pilasters shall be provided under beams that frame into 140 mm unit masonry foundation walls. Pilasters shall be not less than 90 mm by 290 mm and shall be bonded or tied into the wall. The top 200 mm of pilasters shall be solid.

(4) Beam supports carried on footings over permafrost which may be subject to movement shall be kept to the minimum number by increasing the area of individual footings and by spacing them far enough apart to minimize the deflection/span ratio of the supported beams in case of support movement. (See also Section 23H).

F. PARGING AND FINISHING

(1) Concrete block foundation walls shall be parged on the exterior face below ground level as required in Section 13.

(2) All form ties shall be removed at least flush with the concrete surface.

(3) Exterior surfaces of concrete block foundation walls above ground level shall have tooled joints, or shall be rendered, parged or otherwise suitably finished.

G. PILE FOUNDATIONS

(1) Piles used for the support of a building in permafrost areas shall be embedded in the permanently frozen soil to a depth of at least twice the thickness of the soil subject to seasonal thawing, but not less than 3m. Where such piles are placed with the use of heat, the heating shall be controlled to keep disturbance of the permafrost to a minimum.

(2) Wood piles shall meet the requirements of CAN3-056, "Round Wood Piles." Wood piles shall be treated with an acceptable preservative applied to the portion of pile that may be exposed to soil that is subject to seasonal thawing to a point at least 300 mm above adjacent ground level.

SECTION 16. SLABS-ON-GROUND

A. SCOPE

(1) NBC This Section applies to concrete slabs supported on ground or on granular fill which do not provide structural support for the superstructure.

(2) NBC Floor slabs that support loads from the superstructure shall be designed in conformance with Part 4 of the NBC.

(3) NBC Dampproofing and waterproofing shall conform to Section 13.

(4) Insulation shall conform to Section 26.

B. SLAB SUPPORTS

NBC Where fill is used beneath a slab, it shall consist of coarse clean granular material unless it is compacted.

C. DRAINAGE

(1) NBC Except as provided in (2) or where it can be shown to be unnecessary, the accumulation of water underneath a slab-on-ground shall be prevented by grading, drainage or other method.

(2) NBC Where ground water levels may cause hydrostatic pressure beneath the slab, the slab shall be designed to resist such pressures.

(3) NBC Where floor drains are installed (see Section 32), the floor surface shall be sloped so that no water can accumulate.

D. CONCRETE

(1) See also Section 3.

(2) The finished surface of concrete floor slabs shall be trowelled smooth and even. Dry cement shall not be added to the floor surfaces to absorb surplus water.

(3) Where a topping course is provided for concrete floor slabs, it shall consist of 1 part cement to 2 1/2 parts clean well-graded sand by volume, with a water cement ratio approximately equal to that of the base slab.

(4) Concrete slabs-on-ground shall be not less than 75 mm thick exclusive of concrete topping. Where concrete topping is provided, it shall be not less than 20 mm thick.

E. SLABS NOT ON PERMAFROST

Where soil that is susceptible to frost action supports a concrete slab on grade that is not located below the depth of frost penetration, insulation shall be located so that heat from the building is permitted to reach the ground beneath the perimeter of the slab. (See Section 26)

F. SLABS ON PERMAFROST

(1) Provision shall be made to maintain permafrost beneath a slab by the use of granular material, ventilation, insulation, or a combination of these between the slab and the ground.

(2) Where the supporting soil or rock may become unstable on thawing, insulation shall be located so as to maintain the soil in its frozen condition.

(3) The soil under the slab and for a distance of 2 m all around the slab shall not be disturbed except to cut channels to ensure drainage.

(4) A gravel pad of coarse granular material, conforming to Subsection 15C, shall be placed and compacted over the site to a depth of at least 1 m, with the top extending to at least 2 m on all sides beyond the perimeter of the building.

(5) The top of the gravel pad shall be covered with a layer of closed cell foam type insulation with a minimum thermal resistance of 5 RSI to the length and width of the building supported.(See also Subsection 26D)

(6) Edges of the slab shall be insulated to the same value as the underside.

(7) Dampproofing and waterproofing shall conform to Section 13 except that closed cell insulation may be accepted for either purpose, provided that all joints in the insulation have been sealed by a waterproof membrane of at least 0.15 mm polyethylene film, 100 mm wide and bedded in elastomeric sealant over all joints.

(8) Where sub-floor venting is used, burnt clay, concrete or galvanized steel culvert pipes with a diameter of at least 150 mm shall be used, buried in the gravel pad to form vents from one side of the pad to the other, and:

a) the pipes shall be covered with at least 150 mm of gravel, and the bottom of the vent pipes shall be located at least 600 mm below the top surface of the pad and shall be placed at intervals not exceeding 1200 mm on centres,

b) one end of each vent shall connect to a header by means of a tee,

c) the header shall be at least 300 mm in diameter and shall be closed at one end, and the other ends of the vents shall remain open to the atmosphere, and

d) air, at the outside ambient temperature, shall be blown continuously through the header and pad vents, at a rate of at least 5 L/s for each vent.

SECTION 17. COLUMNS

A. SCOPE

(1) This Section applies to columns used to support carport roofs (see Section 36), and beams carrying loads from not more than 2 wood-frame floors, where the length of joists carried by such beams does not exceed 5 m, and the live load on any floor does not exceed 2.4 kN/m^2 (see Table 4.1.6.A, NBC)

(2) Columns for applications other than as described in (1) shall be designed in accordance with Part 4 of the NBC.

B. GENERAL

(1) Columns shall be centrally located on a footing conforming to Section 15.

(2) Columns shall be securely fastened to the supported member to prevent lateral movement.

C. STEEL COLUMNS

(1) Except as permitted in (2), steel pipe columns shall have a minimum outside diameter of 73 mm and a minimum wall thickness of 4.76 mm.

(2) Columns of sizes other than as specified in (1) may be used where the loadbearing capacities are shown to be adequate.

(3) Except as permitted in (4), steel columns shall be fitted with not less than 100 mm by 100 mm by 6.35 mm thick steel plates at each end, and where the column supports a wooden beam, the top plate shall extend across the full width of the beam.

(4) The top plate required in (3) may be omitted where a column supports a steel beam and provision is made for the attachment of the column to the beam.

(5) Steel columns shall be treated on the outside surface with at least 1 coat of rust-inhibitive paint.

(6) Adjustable steel columns shall conform to CGSB 115-GP-1, "Columns, Adjustable, Metal."

D. WOOD COLUMNS

(1) The width or diameter of a wood column shall not be less than the width of the supported member. Except as provided in Article 36E (2), columns shall not be less than 184 mm for round columns and 140 mm by 140 mm for rectangular columns, unless calculations are provided to show that lesser sizes are adequate.

(2) Wood columns shall be either solid, glue-laminated or built-up. Built-up columns shall consist of not less than 38 mm thick full-length members bolted together with not less than 9.52 mm diameter bolts spaced not more than 450 mm o.c., or nailed together with not less than 76 mm nails spaced not more than 300 mm o.c.. Glue-laminated columns shall conform to Section 4.3 of the NBC.

(3) Wood columns shall be separated from concrete in contact with the ground by 0.05 mm polyethylene film or Type S roll roofing.

E. UNIT MASONRY COLUMNS

(1) Unit masonry columns shall be built of loadbearing masonry units.

(2) Unit masonry columns shall be at least 290 mm by 290 mm or 240 mm by 380 mm in size.

F. SOLID CONCRETE COLUMNS

(1) Concrete shall conform to Section 3.

(2) Concrete columns shall be not less than 200 mm by 200 mm for rectangular columns and 230 mm diameter for circular columns.

SECTION 18. CRAWL SPACES

A. GENERAL

(1) This Section applies to all buildings, regardless of size.

(2) This Section applies to all crawl spaces, whether open or enclosed by foundation walls.

(3) Foundation walls enclosing crawl spaces shall conform to Section 15.

(4) Insulation on foundation walls shall conform to Section 26.

(5) Heating of crawl spaces enclosed by foundation walls shall conform to Section 34.

B. ACCESS TO ENCLOSED CRAWL SPACES

(1) An access opening of not less than 500 mm by 700 mm shall be provided to each crawl space where the crawl space serves a single dwelling unit, and not less than 550 mm by 900 mm for other crawl spaces.

(2) Access openings shall be fitted with a door or hatch, except when the access opening into the crawl space is from the adjacent basement and provides ventilation to the crawl space.

C. VENTILATION

(1) Crawl spaces shall be ventilated by natural or mechanical means.

(2) Except as otherwise permitted in (5), natural ventilation for crawl spaces enclosed by foundation walls shall be provided by an opening to the outdoor air by not less than 0.1 m^2 of unobstructed vent area for every 50 m^2 of floor area.

(3) Vents provided in conformance with (2) shall be designed to prevent the entry of snow, rain and insects and shall be provided with tight-fitting covers to prevent air leakage in winter if the crawl space is heated.

(4) Vents provided in conformance with (2) shall be uniformly distributed on opposite sides of the building.

(5) Ventilation to the outside air is not required when the crawl space is used as a warm air plenum, or if the crawl space is vented to an adjacent basement or cellar with an opening conforming to (2).

(6) Subject to the requirements of (H), where a crawl space that is not enclosed by foundation walls is enclosed by a skirting that blocks the passage of the wind, a minimum of 20 percent of the skirting on each face of the building shall be removable to permit the free circulation of outside air in the spring and summer.

D. CLEARANCE

(1) The finished grade in a crawl space shall be not less than 300 mm below the level of all joists and beams (See also H (1)).

(2) Where equipment requiring service as plumbing cleanouts, tanks, traps and burners is located in crawl spaces, an access way with a minimum height and width of 600 mm shall be provided from the access door to the equipment and for a distance of 900 mm on the side or sides of the equipment to be serviced.

E. DRAINAGE

(1) Unless groundwater levels and site conditions are such that water will not accumulate in the crawl space, the crawl space floor and access trenches shall be sloped to drain to a sewer, ditch or dry well.

(2) Drains shall conform to Section 14.

F. GROUND COVER

Dampproofing consisting of not less than 50 mm of asphalt, or 10 MPa portland cement concrete, or 0.15 mm polyethylene, or other approved material, shall be provided in every crawl space enclosed by foundation walls. Joints in sheet-type ground cover shall be lapped not less than 100 mm and weighted down.

G. FIRE PROTECTION

Crawl spaces used as warm-air plenums shall be restricted to 1-storey portions of dwelling units. Enclosing material, including insulation, shall have a surface flame-spread rating not greater than 150. Combustible ground cover shall be covered with noncombustible material or have noncombustible receptacles beneath the register openings.

H. CRAWL SPACES OVER PERMAFROST

(1) Where permafrost must be protected against thawing, skirtings that would block the passage of wind shall not extend closer than 300 mm to the finished grade.

(2) Spaces under houses on foundations supported by permafrost having an active layer shall not be enclosed by skirtings which obstruct the passage of wind, unless the possible increase in the depth of the active layer is taken into consideration in the design of the foundations.

I. PREVENTION OF SNOW DRIFTING

(1) Skirtings which obstruct the passage of wind shall not be used in areas where heavy drifting snow is commonly encountered.

SECTION 19. ROOF SPACES

A. SCOPE

This Section applies to all buildings, regardless of size.

B. VENTILATION OF ROOF SPACES

(1) Attics and roof spaces shall be ventilated to ensure the removal of water vapour, except as provided in (2), (3) or (4).

(2) No ventilation is required where an insulated roof has a slope of more than 1 in 12 and where the insulation is in continuous contact with the roof sheathing, provided that each joist or rafter space is blocked at its highest point to prevent the passage of air, and provided that the air-vapour barrier is drained to the outdoors.

(3) In locations where it is known that the design of a vent to prevent the entry of wind-driven snow is impracticable, roof spaces need not be permanently ventilated. In such cases, vents shall be provided that can be closed tightly in winter and opened in summer, to facilitate the rapid drying out of roof spaces.

(4) Ventilation is not required for the lower portion of a mansard style roof, provided that the upper portion of such a roof is ventilated in conformance with the requirements of this Subsection, and at least 50 per cent of the required vent opening area is provided near the junction of the upper and lower portions of the roof.

(5) Where attic or roof spaces are ventilated, vents shall be provided that have an aggregate area of not less than 1/300 of the insulated ceiling area, and that are located to ensure an even flow of air through the ventilated space.

(6) Roof, eave, gable-end, or any combination of these vent types may be used. The unobstructed vent area shall be determined in conformance with CSA A93-1965 "Vents for Buildings".

(7) Vents shall be designed to prevent the entry of insects and to prevent rain and wind-driven snow from reaching the insulated areas of the roof.

C. INSULATION OF ROOF SPACES

(1) Roof spaces shall be insulated in conformance with Section 26.

(2) Air-permeable insulation in ventilated roofs shall be protected from wind-induced air flow in conformance with Subsection 26D.

(3) Roofs containing insulation and having a slope of not more than 1 in 12 shall have a minimum clearance of 75 mm between the top of the insulation and the underside of the roof deck or sheathing.

(4) Where roof joist or rafter spaces are interconnected by cross purlins that provide a clearance of at least 38 mm above the joist or rafter, the minimum dimension between the top of the insulation and the top of the joist or rafter shall be 25 mm.

(5) Where ventilation openings are located at the eaves of an attic, the required clearance above the insulation may be reduced to 25 mm at the eaves, providing that the area of the opening provided is not less than 1/300 of the area of the insulated ceiling below the roof space being ventilated.

D. ACCESS TO ATTICS

(1) Every attic space more than 600 mm in height at the highest point shall be provided with a hatchway of not less than 550 mm by 900 mm, except that where such hatchway serves not more than 1 dwelling unit, the hatchway may be reduced to 500 mm by 700 mm.

(2) Hatchways to unheated attic space shall be from the outdoors, unless designed in conformance with (3). Hatchways shall be fitted with doors or covers designed to prevent the entry wind or water when closed.

(3) When a hatchway gives access to an unheated attic space from the interior, it shall be fitted with a door or cover which has the same thermal performance that is required for the building envelope in which it is located. The hatchway shall have an airtight seal when closed, and be provided with a positive closing device.

SECTION 20. ABOVE-GRADE MASONRY

A. SCOPE

(1) This Section applies to unreinforced masonry and masonry veneer in which the wall height above the foundation wall does not exceed 11 m, and in which the roof or floor system above the first storey is not of concrete construction.

(2) For buildings other than those described in (1), or where the masonry is designed on the basis of design loads and allowable stresses, Section 4.4 of the NBC shall apply.

(3) In seismic Zone 3, loadbearing elements of masonry buildings more than 1 storey in height shall be reinforced with at least the minimum amount of reinforcement as required in Subsection R.

(4) In seismic Zone 2, loadbearing masonry elements of 3-storey masonry buildings shall be reinforced with at least the minimum amount of reinforcement as required in Subsection R.

B. MASONRY UNITS

(1) Masonry units shall comply with one of the following:

CSA A82.1, "Burned Clay Brick,"
CSA A82.3,"Calcium Silicate (Sand-Lime) Building Brick,"
CSA A82.4, "Structural Clay Load-Bearing Wall Tile,"
CSA A82.5, "Structural Clay Non-Load-Bearing Wall Tile,"
CSA A165.1, Concrete Masonry Units,"
CSA A165.2, "Concrete Brick Masonry Units,"
CSA A165.3, "Prefaced Concrete Masonry Units,"
CSA A165.4, "Autoclaved Cellular Units,"
ASTM C126, "Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units," or
ASTM C212, "Structural Clay Facing Tile."

(2) Used bricks shall be free of old mortar, soot or other surface coating and shall conform to (1).

(3) Glass blocks and gypsum masonry shall not be used as loadbearing units or in the construction of fireplaces or chimneys. Gypsum block shall not be exposed to soil, weather or dampness. Masonry made with foamed concrete shall not be used in contact with the soil or exposed to the weather.

(4) Stone shall be sound and durable.

(5) Loadbearing concrete units or non-loadbearing concrete units exposed to the weather shall have weight and water absorption characteristics conforming to Classes A, B or C, described in CSA A165.1, "Concrete Masonry Units." Where cellular concrete blocks are used, allowance shall be made in the design for the shrinkage characteristics of the units to be used.

(6) Clay brick masonry units exposed to the weather shall have an average saturation coefficient not greater than 0.88 when measured in conformance with CAN3-A82.2, "Methods of Sampling and Testing Brick."

(7) The compressive strength of masonry units shall conform to Table 20A.

TABLE 20A - COMPRESSIVE STRENGTH OF MASONRY

Type of Masonry Unit	Minimum Compressive Strength over Gross Area, MPa	
	Masonry Unit Exposed to Weather	Masonry Unit not Exposed to Weather
Hollow loadbearing concrete units	7	5
Solid loadbearing concrete units	12.5	8
Hollow non-loadbearing concrete units	7	2.5
Solid non-loadbearing concrete units	12.5	8
Solid loadbearing cellular units	Not Permitted	5
Solid non-loadbearing cellular units	Not Permitted	2

C. MORTAR

(1) Cementitious materials and aggregates for mortar shall comply with the following:

NBC
CAN 3-A5, "Portland Cements,"
CAN 3-A8, "Masonry Cement,"
CSA A82.22, "Gypsum Plasters,"
CSA A82.56, "Aggregate for Masonry Mortar."

(2) Water and aggregate shall be clean and free of significant amounts of deleterious materials.

(3) Lime used in mortar shall be hydrated.

(4) NBC If lime putty is used in mortar, it shall be made by slaking quicklime in water not for less than 24h or by soaking hydrated lime in water for not less than 12h.

(5) Except as provided in (6) to (8), mortar mixes shall conform to Table 20B. Mortar containing portland cement shall not be used later than 2 1/2 h after mixing.

TABLE 20B - MORTAR MIX PROPORTIONS (by volume)

Permissible Use of Mortar	Portland Cement	Masonry Cement (Type H)	Lime	Aggregate
All locations but not for use with sand-lime or concrete brick	1/2 to 1 1	1 --	— 1/4 to 1/2	Not less than 2 1/4 and not more than 3 times the sum of the volumes of the cement and lime
All locations except foundation walls and piers, but not for use with sand-lime or concrete brick	-- 1	1 --	— 1/2 to 1 1/4	
All locations except loadbearing walls of hollow units, parapet walls and chimneys	1	—	1 1/4 to 2 1/2	
NBC All non-loadbearing interior walls and all loadbearing walls of solid units, except foundation walls, parapet walls and chimneys	1 —	-- —	2 1/4 to 4 1	

(6) Mortar for sand-lime brick and concrete brick may consist of 1 part masonry cement to not less than 3 parts of aggregate by volume in addition to those mixes permitted in Table 20B.

(7) Mortar for gypsum units shall consist of 1 part gypsum and not more than 3 parts aggregate by weight.

(8) Mortar for glass block shall consist of 1 part portland cement, 1 part hydrated lime to not more than 4 parts aggregate by volume.

D. MORTAR JOINTS

(1) Maximum average joint thickness shall be 12 mm. Maximum thickness of an individual joint shall be 20 mm.

(2) Solid masonry units shall be laid with full head and bed joints.

(3) Hollow masonry units shall be laid with mortar applied to head and bed joints of both inner and outer face shells.

E. MASONRY SUPPORT

(1) All masonry shall be supported on masonry, concrete or steel, except that masonry veneer walls may be supported on foundations of wood frame constructed in conformance with 15B(6).

(2) Masonry over openings shall be supported by steel, reinforced concrete or masonry lintels or arches designed to support the imposed load.

(3) Steel angle lintels supporting masonry veneer above openings shall conform to Table 20C.

(4) Every masonry wall shall be at least as thick as the wall it supports, excepts as otherwise permitted in L(2).

TABLE 20C - MAXIMUM ALLOWABLE SPANS FOR STEEL LINTELS SUPPORTING MASONRY VENEER, m

Minimum Angle Size, mm			75 mm Brick	90 mm Brick	100 mm Stone
Vertical Leg	Horizontal Leg	Thickness			
90	75	6	2.55	----	----
90	90	6	2.59	2.47	2.30
100	90	6	2.79	2.66	2.48
125	90	8	3.47	3.31	3.08
125	90	10	3.64	3.48	3.24

F. THICKNESS AND HEIGHT

(1) Masonry exterior walls, other than cavity walls, in 1-storey buildings and the top storeys of 2-storey buildings shall be not less than 140 mm thick provided the walls are not more than 2.8 m high at the eaves and 4.6 m high at the peaks of gable ends. The exterior walls of the bottom storeys of 2-storey buildings and all walls of 3-storey buildings shall be not less than 190 mm thick. In walls composed of more than 1 wythe, each wythe shall be not less than 90 mm thick.

(2) Cavity walls shall be made with not less than 90 mm-wide units if the joints are raked and not less than 75 mm-wide units if the joints are not raked. Wythes shall be separated by a cavity of not less than 50 mm nor more than 75 mm, except that where the wythes are bonded together with masonry units, the cavity shall be not less than 75 mm and not more than 100 mm. The minimum thickness of cavity walls above the supporting base shall be 230 mm for the top 7.6 m and 330 mm for the remaining portion, except that where 75 mm wide units are used the wall height above the top of the foundation wall shall not exceed 6 m.

(3) The thickness of loadbearing interior walls shall be determined on the basis of J(1).

(4) NBC Interior non-loadbearing walls shall be not less than 65 mm thick (see J(1)).

(5) Masonry veneer resting on a bearing support shall be of solid units not less than 75 mm thick for wall heights up to 11 m. Such veneer over wood-frame walls shall have not less than a 25 mm air space behind the veneer. Masonry veneer less than 90 mm thick shall have unraked joints.

(6) Masonry veneer individually supported by the back-up material shall conform to the appropriate requirements contained in Section 4.4 of the NBC.

(7) The height of parapet walls above the adjacent roof surface shall be not more than 3 times the parapet wall thickness. Parapet walls shall be solid from the top of the parapet to not less than 300 mm below the adjacent roof level.

(8) Limestone slab facings and precast concete panel facings shall conform to the appropriate requirements of Section 4.4 of the NBC.

G. CHASES AND RECESSES

(1) Except as permitted in (3) and (5), the depth of any chase or recess shall not exceed 1/3 the thickness of the wall, and the horizontal projection of the chase or recess shall not exceed 500 mm.

(2) Except as permitted in (3) and (5), no chase or recess shall be constructed in any wall 190 mm or less in thickness.

(3) Recesses may be constructed in 190 mm walls provided they do not exceed 100 mm in depth, 750 mm in height and the horizontal projection of the recess does not exceed 500 mm.

(4) Chases and recesses shall be not less than 4 times the wall thickness apart and not less than 600 mm away from any pilaster, cross wall, buttress or other vertical element providing required lateral support for the wall.

(5) Chases or recesses that do not conform to the limits specified in (1) to (4) shall be considered as openings, and any masonry supported above such a chase or recess shall be supported by a lintel or arch.

(6) Chases and recesses shall not be cut into walls made with hollow units after the masonry units are in place.

H. SUPPORT OF LOADS

NBC

(1) Loadbearing walls of hollow masonry units supporting roof or floor framing members shall be capped with not less than 50 mm of solid masonry, or have the top course filled with concrete. Capping may be omitted where the roof framing is supported on a wood plate not less than 38 mm x 89 mm.

(2) Floor joists supported on cavity walls shall be supported on solid units not less than 57 mm in height. Floor joists shall not project into the cavity. Roof and ceiling framing members bearing on cavity walls shall be supported on not less than 57 mm of solid masonry, bridging the full thickness of the wall, or a wood plate not less than 38 mm thick, bearing not less than 50 mm on each wythe.

(3) The bearing area under beams and joists shall be sufficient to carry the supported load. In no case shall the minimum length of end bearing of beams supported on masonry be less than 90 mm. The minimum length of end bearing of floor, roof or ceiling joists supported on masonry shall be not less than 40 mm.

(4) Beams and columns supported on masonry walls shall be supported on pilasters where the thicknesses of the masonry walls or wythes are less than 190 mm. Not less than 190 mm in depth of solid masonry or concrete shall be provided under the beams or columns. Pilasters shall be bonded or tied to masonry walls. Concrete pilasters shall be not less than 50 mm by 300 mm; unit masonry pilasters shall be not less than 100 mm by 290 mm.

(5) The distance from the face of a wall to the edge of a supporting member attached to the structure, such as a shelf angle or the flange of a beam, shall not exceed 30 mm, except as otherwise permitted in Section 4.4 of the NBC.

I. BONDING AND TYING

NBC

(1) Vertical joints in adjacent courses of walls shall be offset unless each wythe of masonry is reinforced with the equivalent of not fewer than 2 corrosion-resistant steel bars of 3.76 mm diam placed in the horizontal joints at vertical intervals not exceeding 460 mm. Where joints in the reinforcing occur, the bars shall be lapped not less than 150 mm.

(2) Masonry walls that consist of 2 or more wythes shall have the wythes bonded or tied together with masonry bonding units as described in (3) or with metal ties as described in (4) to (6).

(3) Where wythes are bonded together with masonry units, the bonding units shall comprise not less than 4 percent of the wall surface area. Bonding units shall be spaced not more than 600 mm o.c. vertically and horizontally in the case of brick masonry and 900 mm o.c. in the case of block or tile. Such units shall extend not less than 90 mm into adjacent wythes.

(4) Where 2 or more wythes are bonded together with metal ties of the individual rod type, the ties shall conform to the requirements in (5) to (8). Other metal bonding ties may be used where it can be shown that such ties provide walls that are at least as strong and as durable as those made with the individual rod type.

(5) Metal ties of the individual rod type shall be corrosion-resistant and shall have a minimum cross-sectional area of not less than 17.8 mm^2. Such ties shall have not less than a 50 mm portion bent at right angles at each end.

(6) Metal ties of the individual rod type shall extend from within 25 mm of the outer face of the wall to within 25 mm of the inner face of the wall and shall be completely embedded in mortar, except for the portion exposed in cavity walls. Such ties shall be staggered from course to course.

(7) Where 2 or more wythes in walls other than cavity walls are bonded together with metal ties of the individual rod type, the space between wythes shall be completely filled with mortar. Such ties shall be located within 300 mm of openings and spaced not more than 900 mm apart around openings. Ties at other locations shall be spaced not more than 900 mm apart horizontally and 460 mm apart vertically.

(8) Where the inner and outer wythes of cavity walls are bonded together with metal ties of the individual rod type, the ties shall be shaped to provide a drip near their centres. Such ties shall be spaced not more than 600 mm apart horizontally within 100 mm of the bottom of each floor or roof assembly where the cavity extends below the assembly and not more than 900 mm apart around openings within 300 mm of the openings. At other locations, the ties shall be spaced not more than 900 mm apart horizontally and 460 mm apart vertically.

(9) Masonry veneer 75 mm or more in thickness and resting on a bearing support shall be tied to masonry back-up or to wood framing members with not less than 0.41 mm thick, 22 mm wide corrosion-resistant straps spaced in accordance with Table 20D and shaped to provide a key with the mortar.

(10) Masonry veneer individually supported by masonry or wood-frame back-up shall be secured to the back-up in conformance with Section 4.4 of the NBC.

TABLE 20D - VENEER TIE SPACING

Maximum Vertical Spacing, mm	Maximum Horizontal Spacing, mm
400	800
500	600
600	400

(11) Glass block shall have horizontal joint reinforcement of 2 corrosion-resistant bars of not less than 3.76 mm diam or expanded metal strips not less than 75 mm wide spaced at vertical intervals not exceeding 600 mm for units 190 mm or less in height and in every horizontal joint for units higher than 190 mm. Reinforcement shall be lapped not less than 150 mm.

J. LATERAL SUPPORT

(1) NBC Masonry walls and partitions shall be supported at right angles to the wall by floor or roof construction or by intersecting masonry walls or buttresses. The maximum spacing of such supports shall be 20 times the wall thickness for walls of solid units and 18 times the wall thickness for walls of hollow units or cavity walls, except that the spacing of supports for non-loadbearing interior walls shall be not more than 36 times the wall thickness.

(2) Floor and roof constructions providing required lateral support for walls as required in (1) shall be constructed to transfer lateral loads to walls or buttresses approximately at right angles to the laterally supported walls.

K. ANCHORAGE OF ROOFS, FLOORS AND INTERSECTING WALLS

(1) Where required to provide lateral support (see Subsection J), masonry walls shall be anchored to each floor or roof assembly at maximum intervals of 2 m, except that anchorage of floor joists not more than 1 m above grade may be omitted. Ties shall be corrosion-resistant and be not less than the equivalent of 40 mm by 4.76 mm thick steel straps. Such anchors shall be shaped to provide a mechanical key with the masonry and shall be securely fastened to the horizontal support to develop the full strength of the tie. When joists are parallel to the wall, such ties shall extend across at least 3 joists.

(2) Where required to provide lateral support, intersecting walls shall be bonded or tied together. Fifty percent of the adjacent masonry units in the intersecting wall shall be embedded in the laterally supported wall, or corrosion-resistant metal ties equivalent to not less than 4.76 mm by 40 mm steel strapping shall be provided. Such ties shall be spaced not more than 800 mm o.c. vertically and shaped at both ends to provide sufficient mechanical key to develop the strength of the ties.

NBC

(3) Wood-frame walls shall be tied to intersecting masonry walls with not less than 4.76 diam corrosion-resistant steel rods spaced not more than 900 mm o.c. vertically. The ties shall be anchored to the wood framing at one end and shaped to provide a mechanical key at the other end to develop the strength of the tie.

NBC

(4) Roof systems of wood-frame construction shall be tied to exterior walls by not less than 12.7 mm diam anchor bolts, spaced not more than 2.4 m apart, embedded not less than 90 mm into the masonry and fastened to a rafter plate of not less than 38 mm thick lumber. Alternatively, the roof system may be anchored by nailing the wall furring strips to the side of the rafter plate.

(5) Cornices, sills or other trim of masonry material which project beyond the wall face shall have not less than 65 percent of their mass but not less than 90 mm within the wall or shall be adequately anchored to the wall with corrosion-resistant anchors.

(6) Where anchor bolts are to be placed in the top of a pier, the pier shall be capped with concrete or reinforced masonry not less than 300 mm thick.

L. CORBELLING

(1) All corbelling shall consist of solid units. The units shall be corbelled so that the horizontal projection of any unit does not exceed 25 mm and the total projection does not exceed 1/3 the total wall thickness.

(2) Cavity walls of greater thickness than the foundation wall on which they rest shall not be corbelled but may project 25 mm over the outer face of the foundation wall disregarding parging. The unit masonry foundation wall may be corbelled to meet flush with the inner face of a cavity wall provided the individual corbel does not exceed 1/2 the height or 1/3 the width of the corbelled unit and the total corbel does not exceed 1/3 the foundation wall thickness.

(3) Masonry veneer resting on a bearing support shall not project more than 25 mm beyond the supporting base where the veneer is at least 90 mm thick and 12 mm beyond the supporting base where the veneer is less than 90 mm thick. In the case of rough stone veneer, the projection, measured as the average projection of the stone units, shall not exceed 1/3 the bed width beyond the supporting base.

M. FLASHING

(1) Exposed flashing shall consist of not less than 1.73 mm sheet lead, 0.33 mm galvanized steel, 0.36 mm copper, 0.46 mm zinc or 0.48 mm thick aluminum. Aluminum flashing in contact with masonry or concrete shall be effectively coated or separated from the masonry or concrete by an impervious membrane.

(2) Concealed flashing shall consist of not less than 1.73 mm sheet lead, 0.33 mm galvanized steel, 0.36 mm copper, 0.46 mm zinc, Type S roll roofing, 0.15 mm polyethylene or 0.05 mm copper or aluminum laminated to felt or kraft paper.

(3) Fastening devices for flashing shall be corrosion-resistant and compatible with the flashing with respect to galvanic action.

(4) Flashing shall be installed in masonry and masonry veneer walls beneath jointed masonry window sills, over the back and top of parapet walls, over the heads of glass block panels, beneath weep holes and over the heads of window or door openings in exterior walls when the vertical distance between the top of a window or door trim and the bottom edge of the eave exceeds 1/4 of the horizontal eave overhang.

(5) When installed beneath jointed masonry window sills or over the heads of openings, flashing shall extend from the front edge of the masonry up behind the sill or lintel.

(6) Flashing beneath weep holes in cavity walls shall be installed so that it is bedded in both wythes and slopes toward the outside wythe. Such flashing shall be bedded not less than 25 mm in the inside wythe and shall extend to the outside of the outer wythe.

(7) Flashing beneath weep holes in masonry veneer over wood-frame walls shall be installed so that it extends from the front edge of the masonry to 150 mm up behind the sheathing paper.

N. WEEP HOLES

(1) NBC Weep holes spaced not more than 800 mm apart shall be provided at the bottom of the cavity in cavity wall and masonry veneer wall construction, including the cavities above lintels over window and door openings required to be flashed in conformance with M(4).

O. DAMPPROOFING

(1) NBC Where the interior finish of the exterior walls of a building is a type which may be damaged by moisture, exterior masonry walls, other than cavity walls or walls that are protected for their full height by a roof of a carport or porch, shall be covered on the interior surface with sheathing paper conforming to CAN2-51.32, "Sheathing Membrane, Breather Type", lapped at least 100 mm at the joints. Where the insulation effectively limits the passage of water vapour and is applied by a waterproof adhesive or by mortar directly to the masonry, the requirements for sheathing paper do not apply. Flashing shall be provided where water will

accumulate, to lead it to the exterior unless the wall is parged on the interior.

(2) Cavity walls shall be constructed so that mortar droppings are prevented from forming a bridge to allow the passage of rain water across the cavity.

(3) The junction between door and window frames with masonry shall be caulked in conformance with Subsection 28D.

(4) Where no flashing is installed beneath window sills, such sills shall be provided with a drip not less than 25 mm from the wall surface.

P. EXTERIOR FINISH

Above grade walls of concrete block shall be stuccoed, painted or otherwise finished to provide breather-type water repellancy.

Q. PROTECTION

(1) Mortar and masonry shall be maintained at a temperature of not less than 5°C during installation and for not less than 48 h after installation. No frozen material shall be used in the mix.

(2) The top surface of uncompleted masonry exposed to the weather shall be completely covered with a waterproofing material when construction is not in progress.

R. REINFORCEMENT FOR EARTHQUAKE RESISTANCE

(1) Where reinforcement for masonry is required in this Section, masonry walls shall be reinforced horizontally and vertically with steel having a total cross-sectional area of not less than 0.002 times the cross-sectional area of the wall, so that not less than 1/3 of the required steel area is installed either horizontally or vertically and the remainder in the other direction.

(2) Where reinforcement for masonry is required in this Section, it shall be installed in conformance with the requirements for reinforced masonry as contained in CAN3-S304, "Masonry Design and Construction for Buildings"

SECTION 21. CHIMNEYS AND FLUES

A. GENERAL

(1) NBC This Section applies to rectangular chimneys of brick masonry or concrete not exceeding 12 m in height serving fireplaces or appliances having a combined total rated heat output of 120 kW or less, and to flue pipes serving appliances regulated by Subsection 34L.

(2) NBC Factory-built chimneys serving solid fuel-burning appliances shall conform to ULC S629, "Standard for 650°C Factory-Built Chimneys". (See Appendix A, NBC)

(3) NBC Chimneys other than those described in (1) and (2), gas vents, flue pipes serving gas or oil burning appliances and associated equipment shall conform to Section 6.3 of the NBC.

(4) NBC Except for a factory-built chimney located directly above a solid-fuel burning appliance, every factory-built chimney serving a solid-fuel burning appliance shall be provided with a readily accessible tee section to provide access for cleaning the chimney.

(5) NBC The walls of any chimney, gas vent or flue pipe shall be constructed to be gas-tight, smoke-tight and flame-tight.

(6) Chimneys and flues shall be designed to withstand design wind loads at the site.

B. CHIMNEY FLUES

(1) A chimney flue serving a fireplace or incinerator shall not serve any other appliance.

(2) NBC Except as required in (1), 2 or more fuel-burning appliances may be connected to the same chimney flue provided adequate draft is maintained for the connected appliances and the connections are made as described in (3). (See also Table 21A)

(3) Where 2 or more fuel-burning appliances are connected to the same chimney flue, the appliances must be located on the same storey. The connection for a solid-fuel burning appliance shall be below connections for appliances burning other fuels.

NBC

(4) Chimney flues shall not be inclined more than 45 deg to the vertical.

(5) The size of a chimney flue serving 1 or more appliances having a maximum rated input shall conform to Table 21A unless calculations are provided to show that smaller sizes can be justified.

TABLE 21A - FLUE SIZES

Maximum Rated Input of One or More Appliances, kW	Minimum Size of Flue, mm	
	Round	Rectangular
30	150	200 x 200
50	175	200 x 200
80	200	200 x 200
120	225	200 x 300

(6) The minimum size of a chimney flue serving a masonry fireplace shall be 225 mm in diameter for round flues and 200mm by 300 mm for rectangular flues.

(7) Where a chimney flue serves only 1 appliance, the flue area shall be at least equal to that of the flue pipe connected to it.

(8) The width of an oval chimney flue shall not be less than 2/3 its breadth.

(9) Chimney flues for fuel-fired appliances and combustion equipment shall conform to CSA B-139.

(10) A chimney flue for fuel-fired appliances and combustion equipment shall extend not less than 600 mm above the highest point of the roof.

(11) The chimney shall be insulated from a point where it passes through the insulated envelope to its extremity. Sufficient insulation shall be provided to prevent condensation of water vapour of flue gases under steady-state operating conditions.

C. CHIMNEY LININGS

(1) Every masonry or concrete chimney shall have a lining of clay, firebrick or metal.

(2) Chimney liners shall extend from a point not less than 200 mm below the lowest flue pipe connection to a point not less than 50 mm above the chimney cap.

(3) Liners for chimneys shall be constructed so as to prevent condensed flue gases from penetrating the joints and entering the space between the liner and the surrounding masonry.

(4) Clay liners shall conform to ASTM C315, "Clay Flue Linings," Such liners shall be not less than 15.9 mm thick and shall be capable of resisting, without softening or cracking, a temperature of 1,100°C.

(5) Firebrick liners shall conform to ASTM C64-72, "Refractories for Incinerators and Boilers." Such firebrick shall be laid with high temperature cement mortar conforming to CGSB 10-GP-3, "Mortar, Refractory, Air Setting."

(6) NBC Chimney liners shall be installed when the surrounding masonry or concrete is placed. Spaces between the liner and surrounding masonry shall be filled with mortar.

(7) NBC Every clay chimney liner shall be laid in a full bed of high temperature cement mortar conforming to CGSB 10-GP-3, "Mortar, Refractory, Air Setting".

(8) NBC Metal liners shall be constructed of at least 0.3 mm stainless steel.

(9) NBC Metal liners shall only be used in chimneys serving appliances with an intended flue gas temperature not exceeding 540°C.

D. MASONRY AND CONCRETE CHIMNEY CONSTRUCTION

(1) Unit masonry shall conform to Section 20.

(2) Concrete shall conform to Section 3.

(3) Footings for masonry chimneys and concrete chimneys shall conform to the requirements in Section 15.

(4) The top of a chimney shall have a waterproof cap of concrete, masonry or metal. The cap shall slope from the lining and be provided with a drip not less than 25 mm from the chimney wall. Jointed masonry chimney caps shall have flashing installed beneath the cap extending fromthe liner to the drip edge.

(5) A cleanout opening equipped with a metal frame and a tight-fitting metal door shall be installed near the base of the chimney flue.

(6) The walls of a masonry chimney shall be built of solid units not less than 75 mm thick.

(7) Flue liners in the same chimney shall be separated by not less than 75 mm of masonry or concrete exclusive of liners where clay liners are used, or 90 mm of firebrick where firebrick liners are used. Such flue liners shall be installed to prevent significant lateral movement.

(8) Junctions with adjacent materials shall be adequately flashed to shed water.

E. FLUE PIPES

(1) NBC Flue pipes connecting a solid fuel-burning stove, range or space heater to a chimney flue shall be made of ungalvanized sheet steel conforming to Table 21B.

NBC

TABLE 21B - WALL THICKNESS OF FLUE PIPES

Diameter of Flue Pipe,mm	Minimum Thickness, mm
Up to 150	0.33
151 to 200	0.41
201 to 250	0.53
Over 250	0.69

(2) NBC Flue pipes shall be as short and as straight as possible. Single-walled flue pipes shall not exceed 3 m in horizontal length.

(3) The cross-sectional area of the flue pipe shall not be less than the area of the flue outlet of the appliance, except that a tapered reduction in the section of the flue adjacent to the chimney is permitted provided adequate draft is maintained.

(4) The flue pipe connection with the chimney shall be made by a metal thimble or masonry flue ring. The connection shall be tight and made so that the flue pipe does not extend into the chimney flue.

(5) NBC Slip joints in flue pipes shall be a tight fit with a minimum overlap of 40 mm and be secured with screws.

(6) NBC A flue pipe shall be supported by metal or other noncombustible supports, spaced at intervals not exceeding 1 m.

(7) NBC A flue pipe shall not pass through an attic or roof space, closet or similar concealed space or a floor or ceiling of combustible construction.

(8) NBC A flue pipe may pass through a wall of combustible construction, provided a clearance of at least 450 mm is maintained between the flue pipe and the combustible material. This clearance may be reduced to 225 mm when 0.33 mm thick sheet metal is applied at least 25 mm from the flue pipe using noncombustible spacers. (See Appendix A, NBC)

(9) NBC Add-on heat reclaimers shall not be installed on a flue pipe.

F. CLEARANCE FROM COMBUSTIBLE CONSTRUCTION

(1) The clearance between masonry or concrete chimneys and combustible framing shall be not less than 50 mm for interior chimneys and 12 mm for exterior chimneys.

(2) A clearance of not less than 150 mm shall be provided between a cleanout opening and combustible material.

(3) All spaces between masonry or concrete chimneys and combustible framing shall be sealed top or bottom with noncombustible material.

(4) Flooring shall have not less than a 12 mm clearance from masonry or concrete chimneys.

(5) The clearance between flue pipes serving a solid fuel-burning appliance and unprotected combustible material shall be not less than 450 mm, The clearance may be reduced to the values shown in Table 21C where combustible material is protected. (See Appendix A, NBC)

NBC

(6) Joists or beams may be supported on masonry walls which enclose chimney flues provided the combustible members are separated from the flue by a minimum of 290 mm of solid masonry.

TABLE 21C - CLEARANCE BETWEEN A FLUE PIPE AND PROTECTED COMBUSTIBLE MATERIAL

NBC

Type of Protection Applied to the Combustible Material or Flue Pipe Covering All Surfaces Within 450 mm of the Flue Pipe	Clearance Between the Flue Pipe and Combustible Material, mm
6 mm asbestos millboard spaced out 25 mm by noncombustible spacers	300
0.33 mm sheet metal on 6 mm asbestos millboard	300
0.33 mm sheet metal spaced out 25 mm from combustible surfaces or the flue pipe by noncombustible spacers	225
0.33 mm sheet metal on 3 mm asbestos millboard spaced out 25 mm by noncombustible material	225
Ceramic tiles on noncombustible supports and spaced out at least 25 mm by noncombustible material	225
Solid brick wall spaced out at least 25 mm by noncombustible spacers	225

SECTION 22. SITE-BUILT FIREPLACES

A. SCOPE

(1) The requirements of this Section apply to all buildings, regardless of size.

(2) See Section 34 for factory-built fireplaces and solid-fuel appliances.

B. GENERAL

(1) Fireplaces shall be designed and installed to meet the requirements of Subsections 34C and 34D.

(2) Intakes for the provision of outdoor air, as required in 34C, shall be at least as large in effective area as one half of the area of the flue.

(3) Fireplaces shall be constructed and installed so that the insulation and air-vapour barrier of the exterior wall is located on the exterior side of the structure of the fireplace, in accordance with Section 26.

C. FIREPLACE LINERS

(1) Except where a fireplace is equipped with an acceptable steel liner, every fireplace shall have a firebrick liner not less than 50 mm thick for the sides and back, and not less than 25 mm thick for the floor.

(2) Firebrick liners shall be laid with high temperature cement conforming to CGSB 10-GP-3M(1976), "Mortar, Refractory, Air Setting".

D. WALL THICKNESS

(1) Except as provided in (2), the back and sides of a fireplace shall be at least 190 mm thick where a metal liner or a 50 mm thick firebrick liner is used, including the thickness of the masonry liner. Joints between a firebrick liner and the adjacent back-up masonry shall be offset.

(2) Where a steel fireplace liner is used with an air circulating chamber surrounding the firebox, the back and sides of the fireplace shall consist of not less than 90 mm thickness of solid masonry units or 190 mm thickness of hollow masonry units.

E. OPENINGS

Masonry above openings shall be supported by steel lintels conforming to 20E(3), by reinforced concrete or by a masonry arch.

F. HEARTH

(1) Fireplaces shall have a noncombustible hearth extending not less than 400 mm in front of the fireplace opening and not less than 200 mm beyond each side of the fireplace opening.

(2) The hearth shall be supported on not less than a 140 mm thick trimmer arch of solid masonry units or not less than a 100 mm thick reinforced concrete trimmer.

G. DAMPERS

(1) The throat of every fireplace shall be equipped with a metal damper sufficiently large to cover the full area of the throat opening.

(2) The air intake of every fireplace shall be provided with a metal damper sufficiently large to cover the full area of the air intake, and shall be interlocked with the flue damper required in (1) in such a way that the opening of the flue damper will cause the opening of the air damper.

H. SMOKE CHAMBER

(1) The sides of the smoke chamber connecting a fireplace throat with the flue shall not be sloped at an angle greater than 45° to the vertical.

(2) The thickness of masonry walls surrounding the smoke chamber shall be at least 190 mm at the sides, front and back.

I. CLEARANCE OF COMBUSTIBLE MATERIAL

(1) Combustible material shall not be placed on or near the face of a fireplace within 150 mm of the fireplace opening, except that where the combustible material projects more than 38 mm out from the face of the fireplace above the opening, such material shall be at least 300 mm above the top of the opening.

(2) Metal exposed to the interior of a fireplace, such as the damper control mechanism, shall have at least a 50 mm clearance from any combustible material on the face of the fireplace where such metal penetrates through the face of the fireplace.

(3) At least a 100 mm clearance shall be provided between the back and sides of a fireplace and combustible framing.

(4) At least a 50 mm clearance shall be provided between the back and sides of the smoke chamber of a fireplace and combustible framing.

NBC

J. FIREPLACE INSERTS

NBC

Fireplace inserts and their installation shall conform to ULC S628, "Standard for Fireplace Inserts".

SECTION 23. WOOD-FRAME CONSTRUCTION

A. SCOPE

(1) This Section applies to conventional wood-frame construction in which the framing members are spaced not more than 600 mm o.c..

(2) The requirements in this Section with regard to floor framing, subflooring and their fastenings apply to floors for which the design live load does not exceed 2.4 kN/m^2.

(3) The requirements in this Section with regard to wall framing and its fastenings apply to walls which support floors for which the design live load does not exceed 2.4 kN/m^2 on any floor.

(4) Where the conditions in (2) and (3) are exceeded, the design of the framing and fastening shall conform to Section 4.3 of the NBC.

(5) Post and beam, plank frame and manufactured log wall construction shall conform to Section 24.

B. GENERAL

(1) All members shall be so framed, anchored, fastened, tied and braced to provide the necessary strength and rigidity.

(2) Ends of wood joists or beams and other members framing into masonry or concrete shall be treated to prevent decay where the bottom of the member is at or below ground level, or a 12 mm air space shall be provided at the end and sides of the member.

(3) Wood framing members that are not pressure treated with a wood preservative and which are supported on concrete in contact with the ground or fill shall be separated from the concrete by at least 0.05 mm polyethylene film, except that such dampproofing material is not required where the wood member is at least 150 mm above the ground.

(4) Lumber shall conform to the appropriate requirements in Subsection 3 C.

C. NAILS AND STAPLES

(1) Nails specified in this Section shall be common steel wire nails or common spiral nails conforming to CSA B111, "Wire Nails, Spikes and Staples," unless otherwise indicated.

(2) All nails shall be long enough so that not less than 1/2 their length penetrates into the second member. Splitting of wood members shall be minimized by staggering the nails in the direction of the grain and by keeping nails well in from the edges.

(3) Except as provided in (4), nailing of framing shall conform to Table 23A.

(4) Where the bottom wall plate or sole plate of an exterior wall is not nailed to joists or blocking in conformance with Table 23A, the exterior wall may be fastened to the floor framing by having plywood or waferboard sheathing extend down over floor framing and fastened to the floor framing by nails or staples conforming to (5), or by tying the wall framing to the floor framing by 50 mm wide galvanized-metal strips of at least 0.41 mm in thickness, spaced not more than 1.2 m apart, and fastened at each end with at least two 63 mm nails.

(5) Fastening of sheathing and subflooring shall conform to Table 23B. Staples shall not be less than 1.6 mm in diameter or thickness, with not less than a 9.5 mm crown driven with the crown parallel to framing. Roofing nails for the attachment of fibreboard or gypsum sheathing shall not be less than a 3.2 mm in diameter with a minimum head diameter of 11.1 mm.

TABLE 23A - NAILING FOR FRAMING

CONSTRUCTION DETAIL	Minimum Length of Nails, mm	Minimum No. or Maximum Spacing of Nails
Floor joist to plate - toe nail	82	2
Wood or metal strapping to underside of floor joists	57	2
Cross bridging to joists	57	2 each end
Doubled header or trimmer joists	76	300 mm(o.c.)
Floor joist to stud (balloon construction)	76	2
Ledger strip to wood beam	82	2 per joist
Joists to joist splice (see also Table 23F)	76	2 each end
Tail joists to adjacent header joist(end nailed) around openings	82 101	5 3
Each header joist to adjacent trimmer joist (end nailed) around openings	82 101	5 3
Stud to wall plate (each end) toe nail or end nail	63 82	4 2
Doubled studs at openings, or studs at walls or wall intersections and corners	76	750 mm(o.c.)
Doubled top wall plates	76	600 mm(o.c.)
Bottom wall plate or sole plate to joists or blocking (exterior walls)[1]	82	400 mm(o.c.)
Interior walls to framing or sub-flooring	82	600 mm(o.c.)
Horizontal member over openings in non-load bearing walls - each end	82	2
Lintels to studs	82	2 at each end
Ceiling joist to plate-toe nail each end	82	2
Roof rafter, roof truss or roof joist to plate-toe nail	82	3
Rafter plate to each ceiling joist	101	2
Rafter to joist (with ridge supported)	76	3
Rafter to joist (with ridge unsupported)	76	see Table 23F
Gusset plate to each rafter at peak	57	4
Rafter to ridge board-toe nail -end nail	57 82	4 3
Collar tie to rafter -each end	76	3
Collar tie lateral support to each collar tie	57	2
Jack rafter to hip or valley rafter	82	2
Roof strut to rafter	76	3
Roof strut to bearing wall - toe nail	82	2
38 mm by 140 mm or less plank decking to support	82	2
Plank decking wider than 38 mm by 140 mm to support	82	3
38 mm edge laid plank decking to support (toe nail)	76	1
38 mm edge laid plank to each other	76	450 mm(o.c.)

Note to Table 23A: See 23C(4).

TABLE 23B - SHEATHING AND SUBFLOOR ATTACHMENT

Element	Minimum Length of Fasteners for Sheathing and Subfloor Attachment, mm				Min. No. or Max. Spacing of Fasteners
	Common or Spiral Nails	Ring Thread Nails	Roofing Nails	Staples	
Plywood or waferboard up to 10 mm thick	51	45	N/A	38	150 mm(o.c.) along edges and 300 mm (o.c.) along immediate supports
Plywood or waferboard from 10 mm to 20 mm thick	51	45	N/A	51	
Plywood or waferboard over 20 mm thick	57	51	N/A	N/A	
Fibreboard sheathing up to 13 mm thick	N/A	N/A	44	38	
Gypsum sheathing up to 13 mm thick	N/A	N/A	44	N/A	
Board lumber 184 mm or less wide	51	N/A	N/A	51	2 per support
Board lumber more than 184 mm wide	51		N/A	51	3 per support

D. ALLOWABLE SPANS

(1) Except as required in (3), the spans for wood joists, rafters and beams shall conform to the spans shown in Tables A-1 to A-11 for the uniform live loads shown in the tables. (See Appendix A, NBC)

(2) The spans for steel beams with laterally supported top flanges that support floors in 1 and 2-storey houses shall conform to Table 23C, and such beams shall be constructed of steel having a strength at least equal to Grade 300W steel in CAN3-G40.21, "Structural Quality Steels." (See Appendix A, NBC)

TABLE 23C

MAXIMUM SPANS FOR STEEL BEAMS SUPPORTING FLOORS IN DWELLINGS, m

No. of Storeys Supported	Beam Type	Supported Joist Length (Half the Sum of Joist Spans on Both Sides of the Beam)				
		2.4 m	3.0 m	3.6 m	4.2 m	4.8 m
1	S100 x 11	4.20	3.77	3.44	3.19	2.98
	S130 x 15	5.33	4.78	4.38	4.06	3.80
	S150 x 19	6.47	5.80	5.31	4.92	4.61
	W150 x 22	6.95	6.23	5.71	5.29	4.96
	W200 x 27	9.18	8.24	7.54	7.00	6.56
	S200 x 27	9.05	8.13	7.45	6.91	6.55
2	S100 x 11	3.18	2.84	2.60	2.41	2.25
	S130 x 15	4.04	3.62	3.31	3.06	2.87
	S150 x 19	4.91	4.40	4.02	3.72	3.49
	W150 x 22	5.27	4.73	4.32	4.00	3.75
	W200 x 27	6.97	6.25	5.72	5.30	4.96
	S200 x 27	6.88	6.17	5.65	5.23	4.90

NBC

(3) Where a floor is required to be designed to support a concentrated load or to support a uniform live load in excess of those shown in Tables A1 to A16, (see Appendix A, NBC), such spans shall be determined in conformance with Section 4 of the NBC.

NBC

(4) Where a floor is required to support a concrete topping, the spans shown in Tables A-2 and A-3, or the spacing of the members, shall be reduced to support the loads due to the topping (see Appendix A, NBC).

E. NOTCHING AND DRILLING

(1) Holes drilled in roof, floor or ceiling framing members shall be not larger than 1/4 the depth of the member and shall be located not less than 50 mm from the edges unless the depth of the member is increased by the size of the hole.

(2) Floor, roof and ceiling framing members may be notched provided the notch is located on the top of the member within 1/2 the joist depth from the edge of bearing and is not deeper than 1/3 the joist depth unless the depth of the member is increased by the size of the notch.

(3) Wall studs shall not be notched, drilled or otherwise damaged so that the undamaged portion of the stud is less than 2/3 the depth of the stud if the stud is loadbearing or 40 mm if the stud is non-loadbearing unless the weakened studs are suitably reinforced.

NBC

(4) Top plates in walls shall not be notched, drilled or otherwise weakened to reduce the undamaged width to less than 50 mm unless the weakened plates are suitably reinforced.

(5) Roof truss members shall not be notched, drilled or otherwise weakened unless such notching or drilling is allowed for in the design of the truss.

F. ANCHORAGE

(1) Building frames shall be anchored to the ground to resist uplift and lateral movement unless a structural analysis of wind and earth pressures shows that anchorage is not required.

(2) Except as provided in (4), anchorage shall be provided by embedding the ends of the first floor joists in concrete or fastening the sill plate to the foundation with not less than 12.7 mm diam anchor bolts spaced not more than 2.4 m o.c. Such anchor bolts shall be embedded not less than 100 mm in the foundation and so designed that they may be tightened without withdrawing them from the foundation.

(3) Exterior columns and posts shall be anchored to resist uplift and lateral movement.

(4) Buildings not more than 4.3 m in width and not more than 1 storey in building height may be anchored by means of corrosion-resistant steel rods or cables of at least 12.7 mm diameter, attached to the building frame near each corner of the building in a manner that will develop the full strength of the rod or cable. Each rod or cable shall be anchored to the ground by means of ground anchors having a withdrawal resistance of not less than 500 N/m length of the building.

G. SILL PLATES

(1) Where sill plates provide bearing for the floor system, they shall be not less than 38 mm by 89 mm material.

(2) Sill plates shall be levelled by setting them on a full bed of mortar, except that where the top of the foundation is level, they may be laid directly on the foundation provided the junction between foundation and sill plate is caulked or sealed in an acceptable manner.

H. BEAMS TO SUPPORT FLOORS

(1) Beams shall have even and level bearing. Beams shall have not less than 89 mm length of bearing at end supports.

(2) Steel beams shall be shop primed.

(3) Beams supported by piers or footings which may be subject to differential movement due to changes in permafrost shall be designed with deep section steel or wood members, preferably in one piece, but in any case with moment transfer connections over the supports, such that the disabling of any one support due to permafrost action will not result in a deflection greater than 1/180 (see Section 15E). Beams not subject to differential movement may be designed as in (4) to (8) below.

(4) Where a beam is made up of individual pieces of lumber that are nailed together, the individual members shall be 38 mm or greater in thickness and installed on edge.

(5) NBC Except as permitted in (6), where individual members of a built-up beam are butted together to form a joint, the joint shall occur over a support.

(6) NBC Where a beam is continuous over more than 1 span, individual members are permitted to be butted together to form a joint at or within 150 mm of the end quarter points of the clear spans, provided the quarter points are not those closest to the ends of the beam.

(7) NBC Joints in individual members of beams that are located at or near the end quarter points shall not occur in adjacent members at the same quarter point and shall not reduce the effective beam width by more than half.

(8) NBC Not more than 1 butt joint shall occur in any individual member of a built-up beam within any 1 span.

(9) Except as provided in (10), where 38 mm members are laid on edge to form a built-up beam, individual members shall be nailed together with a double row of nails at least 89 mm in length, spaced not more than 450 mm apart in each row, with the end nails located 100 to 150 mm from the end of each piece.

(10) Where 38 mm members built-up wood beams are not nailed together as provided in (9), they shall be bolted together with at least 12.7 mm diam bolts equipped with washers and spaced not more than 1.2 m o.c., with the end bolts located not more than 600 mm from the ends of the members.

(11) Beams shall be braced as required to resist overturning and lateral distortion under the design loads.

I. FLOOR JOISTS

(1) Except when supported on ribbon boards, floor joists shall have not less than 38 mm length of end bearing. Ribbon boards shall be not less than 19 mm by 89 mm lumber let into the studs.

(2) Floor joists may be supported on the top of beams or may be framed into the sides of beams.

(3) When framed into the side of a wooden beam, joists shall be supported on joist hangers or other acceptable mechanical connectors or on not less than 38 mm by 64 mm ledger strips nailed to the side of the beam, except that 38 mm ledger strips may be used provided each joist is nailed to the beam by at least four 89 mm nails, in addition to the nailing for the ledger strip required in Table 23A.

(4) When framed into the side of steel beams, joists shall be supported on the bottom flange of the beam or on not less than 38 mm by 38 mm lumber bolted to the web with not less than 6.3 m diam bolts spaced not more than 600 mm apart. Such joists shall be spliced above the beam with not less than 38 mm by 38 mm lumber at least 600 mm long to support the flooring. Not less than a 12 mm space shall be provided between the splice and the beam to allow for shrinkage of the wood joists.

(5) Except as provided in (8), the bottom of floor joists shall be restrained from twisting at each end by toe-nailing to the supports, end nailing to the header joists or by providing continuous strapping, blocking between the joists or cross-bridging near the supports.

(6) Except as provided in (8), and except where a floor joist span is at least 460 mm less than the maximum span permitted in Tables A-2 and A-3 (in Appendix A, NBC), provision shall be made for load distribution between joists by the use of multiple bridging located not more than 2.1 m from each support and at intermediate locations so that the distance between rows of bridging does not exceed 2.1 m.

(7) Multiple bridging in (6) shall consist of at least 19 mm by 64 mm or 38 mm by 38 mm cross bridging or solid blocking securely fastened between joists, together with continuous wood strapping of at least 19 mm by 64 mm in size nailed to the bottom of the joists and fastened at each end to the header or sill, except that where a ceiling finish is provided no continuous strapping is required.

(8) Joist restraint or bridging required by (5) and (6) is not necessary when a panel-type subfloor is fastened to the joists with an adhesive in addition to the mechanical fasteners required by Subsection 23C.

(9) Header joists around floor openings shall be doubled when they exceed 1.2 m in length. The size of header joists exceeding 3.2 m in length shall be determined by calculations.

(10) Trimmer joists around floor openings shall be doubled when the length of the header joist exceeds 800 mm. When the header joist exceeds 2.0 m in length, the size of the trimmer joist shall be determined by calculations.

(11) When tail joists and header joists are supported by the floor framing, they shall be supported by suitable joist hangers or nailing.

(12) NBC Non load-bearing walls parallel to the floor joists shall be supported by joists beneath the wall or on blocking between the joists. Blocking for the support of non-loadbearing walls shall be not less than 38 mm by 89 mm lumber, spaced not more than 1.2 m apart.

(13) NBC Non-loadbearing interior walls at right angles to the floor joists are not restricted as to location.

(14) Loadbearing interior walls parallel to floor joists shall be supported by beams or walls of sufficient strength to transfer safely the design loads to the vertical supports.

(15) Loadbearing interior walls at right angles to floor joists shall be located not more than 900 mm from the joist support when the wall does not support a floor, and not more than 600 mm from the joist support when the wall supports 1 or more floors, unless the joint size is designed to support such loads.

(16) Floor joists supporting roof loads shall not be cantilevered more than 400 mm beyond their supports where 38 x 184 mm joists are used and not more than 600 mm beyond their supports where 38 x 235 mm or larger joists are used. The cantilevered portions shall not support floor loads from the other storeys unless calculations are provided to show that the allowable design stresses of the cantilevered joists are not exceeded.

(17) Where cantilevered floor joists described in (16) are at right angles to the main floor joist, the tail joists in the cantilevered portion shall extend inward away from the cantilever support a distance equal to at least 6 times the length of the cantilever and end nailed to an interior doubled header joist in conformance with Table 23A.

J. WALL STUDS

(1) The size and spacing of studs shall conform to Table 23D.

(2) NBC Wall studs shall be placed at right angles to the wall face, except that studs on the flat may be used in gable ends of roofs that contain only unfinished space or in non-loadbearing interior walls within the limits described in (1). Wall studs that support only a load from an attic not accessible by a stairway may also be placed on the flat within the limits permitted in (1) provided the studs are clad on at least 1 side with plywood or waferboard sheathing fastened to the face of the studs with a structural adhesive and the portion of the roof supported by the studs does not exceed 2.1 m in width.

(3) NBC Wall studs shall be continuous for the full storey height except at openings and shall not be spliced except by finger jointing with structural adhesive.

(4) Corners and intersections shall be designed to provide adequate support for the vertical edges of interior and exterior cladding materials, and in no instance shall exterior corners be framed with less than the equivalent of 2 studs. Where the vertical edges of interior cladding at wall intersections are supported at vertical intervals by blocking of other acceptable method, the vertical distance between such supports shall not exceed the maximum distance between supports specified in Section 30.

(5) Except as provided in (6), studs shall be doubled on both sides of openings so that the inner studs extend from the lintel to the bottom wall plate and the outer studs extend from the top wall plate to the bottom wall plate.

(6) NBC Single studs may be used on either side of openings in non-loadbearing interior walls not required to have fire-resistance ratings, provided the studs extend from the top wall plate to the bottom wall plate.

TABLE 23D-SIZE AND SPACING OF STUDS

Type of Wall	Supported Loads (including dead loads)	Minimum Stud Size, mm	Maximum Stud Spacing, mm	Maximum Unsupported Height, m
Interior	No load	38 x 38 38 x 89 flat[1]	400 400	2.4 3.6
	Attic not accessible by a stairway	38 x 64 38 x 64 flat[1] 38 x 89 38 x 89 flat[1]	600 400 600 400	3.0 2.4 3.6 2.4
	Attic accessible by a stairway plus 1 floor, Roof load plus 1 floor, Attic not accessible by stairway plus 2 floors	38 x 89	400	3.6
	Roof load, Attic accessible by a stairway, Attic not accessible by stairway plus 1 floor	38 x 89 38 x 64	600 400	3.6 2.4
	Attic accessible by a stairway plus 2 floors or roof load plus 2 floors	38 x 89 64 x 89 38 x 140	300 400 400	3.6 3.6 4.2
	Attic accessible by a stairway plus 3 floors or roof load plus 3 floors	38 x 140	300	4.2
Exterior	Roof with or without attic storage	38 x 64 38 x 89	400 600	2.4 3.0
	Roof with or without attic storage plus 1 floor	38 x 89 38 x 140	400 600	3.0 3.0
	Roof with or without attic storage plus 2 floors	38 x 89 64 x 89 38 x 140	300 400 400	3.0 3.0 3.6
	Roof with or without attic storage plus 3 floors	38 x 140	300	1.8

Note to Table 23D: (1) See 23J (2)

K. WALL PLATES

(1) Wall plates shall be not less than 38 mm thick and shall be the same width as the wall studs, except that in non-loadbearing partitions and in loadbearing walls where the studs are located directly over framing members, the bottom wall plate may be 19 mm thick.

(2) A bottom wall plate shall be provided in all cases. The bottom plate in exterior walls shall not project more than 1/3 the plate width of the support.

(3) Except as permitted in (4) to (6), no fewer than 2 top plates shall be provided in loadbearing walls and partitions.

(4) A single top plate may be used in a section of a loadbearing wall containing a lintel providing the top plate forms a tie across the lintel.

(5) A single top plate may be used in loadbearing walls where the concentrated loads from ceilings, floors and roofs are not more than 50 mm to one side of the supporting studs and in all non-loadbearing partitions.

(6) The top plates may be omitted in a section of loadbearing wall containing a lintel providing the lintel is tied to the adjacent wall section with not less than 75 mm by 150 mm 0.91 mm thick galvanized steel or a 19 mm by 89 mm by 300 mm wood splice nailed to each wall section with no fewer than three 63 mm nails.

(7) Joints in top plates of loadbearing walls shall be staggered at least 1 stud spacing.

(8) The top plates in loadbearing walls shall be lapped or otherwise suitably tied at corners and intersecting walls. Joints in single top plates used with loadbearing wall shall be suitably tied. Such ties shall be the equivalent of at least 75 mm by 150 mm 0.91 mm thick galvanized steel nailed to each wall with at least the equivalent of three 63 mm nails.

TABLE 23E-WOOD LINTEL SPANS

Location of Lintels	Supported Loads Including Dead Loads and Ceiling	Nominal Depth of Lintels, mm	Maximum Allowable Spans, m
Interior walls	Limited attic storage	89 140 184 235 286	1.22 1.83 2.44 3.05 3.81
	Full attic storage or roof load or limited attic storage plus 1 floor	89 140 184 235 286	0.61 0.91 1.22 1.52 1.83
	Full attic storage plus 1 floor or roof load plus 1 floor or limited attic storage plus 2 or 3 floors	89 140 184 235 286	— 0.76 0.91 1.22 1.52
	Full attic storage plus 2 or 3 floors or roof load plus 2 or 3 floors	89 140 184 235 286	— 0.61 0.91 1.07 1.22
Exterior walls	Roof with or without attic storage	89 140 184 235 286	1.12 1.68 2.24 2.79 3.35
	Roof with or without attic storage plus one floor	89 140 184 235 286	0.56 1.40 1.96 2.24 2.51
	Roof with or without attic storage plus 2 or 3 floors	89 140 184 235 286	0.56 1.12 1.68 1.96 2.24

L. FRAMING OVER OPENINGS

(1) Except as provided in (2), openings in non-loadbearing walls shall be framed with not less than 38 mm material the same width as the studs securely nailed to adjacent studs.

(2) Openings for doors in non-loadbearing walls required to be fire separations with a fire-resistance rating shall be framed with the equivalent of at least two 38 mm thick members that are the same width as the wall plates.

(3) Openings in loadbearing walls shall be framed with lintels designed to carry the super-imposed loads to adjacent studs. Except as provided in (5), where 2 or more members are used in lintels, they shall be fastened together with not less 82 mm nails in a double row, with nails not more than 450 mm apart in each row. the lintel members may be separated by filler pieces.

(4) In buildings of residential occupancy where the wall studs exceed 38 mm by 64 mm in size, and where the spans of supported joist do not exceed 4.9 m and the spans of trusses do not exceed 9.8 m, the spans for wood lintels shown in Table 23E may be used. Such lintels shall consist of a single piece of lumber 89 mm thick or 2 pieces of 38 mm thick lumber on edge.

(5) In loadbearing exterior and interior walls of 38 mm by 64 mm framing members, lintels shall consist of solid 64 mm thick members on edge or 38 mm thick and 19 mm thick members securely nailed together. Such lintels shall be at least 38 mm greater in depth than those shown in Table 23E for the allowable spans and shall not exceed 2.4 m in length.

M. ROOF AND CEILING FRAMING

(1) Roof rafters, joists and ceiling joists shall be continuous or shall be spliced over vertical supports that extend to suitable bearing.

(2) Roof and ceiling framing members shall be doubled on each side of openings greater than 2 rafter or joist spacings in width.

(3) The length of end bearing of joists and rafters shall be not less than 38 mm.

(4) Rafters shall be located directly opposite each other and tied together at the peak or may be offset by their own thickness if nailed to a ridge board not less than 17.5 mm thick. Framing members shall be connected by gusset plates or nailing at the peak in conformance with Table 23A, except that where the roof framing on opposite sides of the peak is assembled separately, such as is the case of factory built houses, the roof framing on opposite sides may be fastened together with galvanized steel strips at least 200 mm by 75 mm by 0.41 mm thick, spaced not more than 1.2 m apart and nailed at each end to the framing by at least two 63 mm nails.

(5) Rafters shall be shaped at supports to provide even bearing surfaces and supported directly above the exterior walls.

(6) Hip and valley rafters shall be not less than 50 mm greater in depth that the common rafters and not less than 38 mm thick, actual dimension.

(7) Ceiling joists and collar ties of not less than 38 mm by 89 mm lumber may be assumed to provide intermediate support to reduce the span for rafters and joists where the roof slope is 1 in 3 or greater. Such collar ties more than 2.4 m in length shall be laterally supported near their centres by not less than 19 mm by 89 mm continuous members at right angles to the collar ties.

(8) Dwarf walls and struts may be used to provide intermediate support to reduce the span for rafters and joists. When struts are used they shall be not less than 38 mm by 89 mm material extending from each rafter to a loadbearing wall at an angle of not less than 45° to the horizontal.

(9) When dwarf walls are used for rafter support, they shall be framed in the same manner as loadbearing walls and securely fastened top and bottom to the roof and ceiling framing to prevent over-all movement. Solid blocking shall be installed between floor joists beneath dwarf walls that enclose finished rooms.

(10) Except as provided in (11), the ridge of the roof shall be supported by a loadbearing wall extending from the ridge to suitable bearing or by a ridge beam of not less than 38 mm by 140 mm material. Such ridge beam shall be supported at intervals not exceeding 1.2 m by not less than 38 mm by 89 mm members extending vertically from the ridge to suitable bearing.

(11) When the roof slope is 1 in 3 or more, ridge support may be omitted provided the lower ends of the rafters are adequately tied to prevent outward movement. These ties may consist of tie rods or ceiling joists forming a continuous tie for opposing rafters and nailed in accordance with Table 23F. Ceiling joists shall be fastened together with at least 1 more nail per joist splice than required for the rafter to joist connection shown in the Table. Members may be fastened together either directly or through a gusset plate.

TABLE 23F - MINIMUM RAFTER-TO-JOIST NAILING

(Minimum Number of Nails at Least 76 mm Long)
(Unsupported Ridge)

NBC

Roof Slope	Rafter Spacing mm	Rafter Tied to Every Joist						Rafter Tied to Joist Every 1.2 m					
		Building Width up to 8 m			Building Width up to 9.8 m			Building Width up to 8 m			Building Width up to 9.8 m		
		Ground Snow Load, kN/m2											
		1.7 or less	2.5	3.3 or more	1.7 or less	2.5	3.3 or more	1.7 or less	2.5	3.3 or more	1.7 or less	2.5	3.3 or more
1 in 3	400	4	5	6	5	7	8	11	—	—	—	—	—
	600	6	8	9	8	—	—	11	—	—	—	—	—
1 in 2.4	400	4	4	5	5	6	7	7	10	—	9	—	—
	600	5	7	8	7	9	11	7	10	—	—	—	—
1 in 2	400	4	4	4	4	4	5	6	8	9	8	—	—
	600	4	5	6	5	7	8	6	8	9	8	—	—
1 in 1.71	400	4	4	4	4	4	4	5	6	8	7	9	11
	600	4	4	5	5	6	7	5	6	8	7	9	11
1 in 1.33	400	4	4	4	4	4	4	4	5	6	5	6	7
	600	4	4	4	4	4	5	4	5	6	5	6	7
1 in 1	400	4	4	4	4	4	4	4	4	4	4	4	5
	600	4	4	4	4	4	4	4	4	4	4	4	5
Col. 1	2	3	4	5	6	7	8	9	10	11	12	13	14

NBC

(12) Roof joists supporting a finished ceiling other than plywood or waferboard shall be restrained from twisting along the bottom edges by means of furring, blocking, cross bridging or strapping conforming to I(5) to I(8).

(13) Ceiling joists supporting part of the roof load from the rafters shall be not less than 25 mm greater in depth than required for ceiling joists not supporting part of the roof load, except that when the roof slope is 1 in 4 or less, the ceiling joist sizes shall be determined from the span tables for roof joists.

NBC

(14) Except for roof trusses constructed of Poplar, Eastern White Pine, Western White Pine, Red Pine, Western Red Cedar and Eastern White Cedar, the member sizes for Howe or Fink type wood roof trusses spaced not more than 600 mm o.c. which are to be supported at or near their ends may be determined in conformance with Tables A-12 and A-13 provided such trusses conform to the requirements of (15) and (16). The joint connections used in such trusses shall be designed in conformance with the requirements in Section 4.3 of the NBC. (See Appendix A, NBC)

NBC

(15) Where a roof truss in (14) supports a ceiling, and the unsupported length of the bottom chord between the truss panel points exceeds 3.05 m, the bottom chord shall be at least 38 mm by 114 mm in size. Where the unsupported length of the bottom chord exceeds 3.66 m between panelpoints, the bottom chord shall be at least 38 mm by 140 mm in size.

NBC

(16) Where the length of compression web members in roof trusses in (14) exceeds 1.83 m, such web members shall be provided with continuous bracing to prevent buckling. Such bracing shall consist of not less than 19 mm by 89 mm lumber nailed at right angles to the web members near their centres with at least two 63 mm nails for each member. Web members shall be at least 38 mm by 89 mm lumber of not less than No. 2 grade.

(17) Roof trusses that are not designed in conformance with (14) shall be capable of supporting a total ceiling load (dead load plus live load) of 0.5 kN/m^2 plus 2 2/3 the design roof load for 24 h, and shall not exceed the deflections shown in Table 23G when loaded with the ceiling load plus 1 1/3 the design roof snow load for 1 h. Testing of lumber roof trusses shall be in conformance with CSA S307, "Load Test Procedure for Wood Roof Trusses for Houses and Small Buildings", except that the unsymmetrical loading requirement in Clause 7.7 of that standard shall not apply.

TABLE 23G - MAXIMUM ROOF TRUSS DEFLECTIONS

Truss Span	Type of Ceiling	Maximum Deflection
4.3 m or less	Plaster or gypsum board	1/360 of the span
	Other than plaster or gypsum board	1/180 of the span
over 4.3 m	Plaster or gypsum board	1/360 of the span
	Other than plaster or gypsum board	1/240 of the span

N. SUBFLOORING

(1) Subflooring shall be provided beneath finish flooring where the finish flooring does not have adequate strength to support the design loads (see Subsection 31C).

(2) Plywood for subfloors shall be exterior type conforming to CSA 0121, "Douglas Fir Plywood," CSA 0151, "Canadian Softwood Plywood" or CSA 0153, "Poplar Plywood," Waferboard subflooring shall conform to CAN3-0188.2, "Waferboard."

NBC

(3) Particleboard subflooring may be used only where a building is constructed in a factory so that the subfloor will not be exposed to the weather. Such subflooring shall conform to grade N-1 or N-2 in CAN3-0188.1, "Interior Mat-Formed Wood Particle-board." Such subflooring shall have its upper surface and all edges treated to restrict water absorption where the subfloor is used in bathrooms, kitchens, laundry rooms or other areas subject to periodic wetting. (See Appendix A, NBC)

(4) Where the edges of panel-type subflooring are required to be supported (see 31B(2)), such support shall consist of tongue-and-groove panel edges or not less than 38 mm by 38 mm blocking securely nailed between framing members.

(5) Plywood subflooring shall be installed with the surface grain at right angles to the joists and with joints parallel to floor joists staggered.

(6) Except as provided in Article (7), subfloors shall conform to Table 23H.

NBC

TABLE 23H - THICKNESS OF SUBFLOORING

Maximum Spacing of Supports, mm	Minimum Plywood Thickness, mm	Minimum Waferboard Thickness, mm	Minimum Particleboard Thickness, mm	Minimum Lumber Thickness, mm
400	15.5	15.9	15.9	17.0
500	15.5	15.9	19.0	19.0
600	18.5	19.0	25.4	19.0

NBC

(7) Where the finished flooring consists of not less than 19 mm matched wood strip flooring laid at right angles to the joists, 12.5 mm thick plywood or 12.7 mm thick waferboard shall be permitted for joists up to 600 mm o.c. Where a separate panel-type underlay or concrete topping is applied to a subfloor, the subfloor may consist of 12.5 m thick plywood or 12.7 mm waferboard for joists up to 400 mm o.c.

(8) When resilient flooring is applied directly to a waferboard, particleboard or plywood subfloor, the subfloor shall be fastened to the supports with annular grooved nails.

(9) Lumber subflooring shall be laid at an angle of not less than 45 deg. to the joists. Lumber subflooring shall be fully supported at the ends on solid bearing. Lumber shall be of uniform thickness and not more than 184 mm wide.

O. ROOF SHEATHING

(1) Plywood used for roof sheathing shall be exterior type plywood conforming to CSA 0121, "Douglas Fir Plywood, " CSA 0151, "Canadian Softwood Plywood" or CSA 0153, "Poplar Plywood." Waferboard for roof sheathing shall conform to CAN3-0188.2, "Waferboard."

(2) Plywood roof sheathing shall be installed with the surface grain at right angles to the roof framing.

(3) Waferboard and plywood roof sheathing shall be installed with at least a 2 mm gap between sheets.

(4) Lumber roof sheathing shall not be more than 286 mm wide and shall be applied so that all ends are supported with end joints staggered.

(5) Where panel-type roof sheathing requires edge support, the support shall consist of metal H clips or not less than 38 mm blocking securely nailed between framing members.

(6) The thickness of roof sheathing on a flat roof used as a walking deck shall conform to the requirements in Table 23H for subfloors. The thickness of roof sheathing on a roof not used as a walking deck shall conform to Table 23I.

NBC

TABLE 23I - THICKNESS OF ROOF SHEATHING

Maximum Spacing of Supports, mm	Minimum Plywood Thickness, mm		Minimum Waferboard Thickness, mm		Minimum Lumber Thickness, mm
	Edges Supported	Edges Unsupported	Edges Supported	Edges Unsupported	
300	7.5	7.5	9.5	9.5	17.0
400	7.5	9.5	9.5	11.1	17.0
600	9.5	12.5	11.1	12.7	19.0

(7) Asphalt-coated or asphalt-impregnated fibreboard at least 11.1 mm thick conforming to CSA A247, "Insulating Fibreboard" may be used as a roof sheathing over supports spaced not more than 400 mm o.c. provided the roofing consists of a continuous sheet of galvanized steel of at least 0.33 m in thickness or a continuous sheet of alumimum of at least 0.61 mm in thickness. All edges of such sheathing shall be supported by blocking or framing.

P. WALL SHEATHING

(1) Exterior walls and gable ends shall be sheathed when the exterior cladding requires intermediate fastening between supports or if the exterior cladding requires solid backing.

(2) Where wall sheathing is required, it shall conform to Table 23J.

NBC

TABLE 23J - WALL SHEATHING THICKNESS AND SPECIFICATIONS

Type of Sheathing	Minimum Thickness, mm[1]		Material Standards
	With Supports 400 mm o.c.	With Supports 600 mm o.c.	
Lumber	17.5	17.5	See Table 3B
Fibreboard (insulating)	9.5	11.1	CSA A247
Gypsum Board	9.5	12.7	CSA A82.27
Plywood (Exterior)	6.0	7.5	CSA O121 CSA O151 CSA O153
Waferboard	6.35	7.9	CAN3-O188.2
Expanded Polystyrene Types 1 and 2	38.0	38.0	CGSB51-GP-20
Expanded Polystyrene Types 3 and 4	25.0	25.0	CGSB51-GP-20
Urethane and Isocyanurate, Types 1, 2 and 4	38.0	38.0	CGSB51-GP-21
Urethane and Isocyanurate, Type 3	25.0	25.0	CGSB51-GP-21
Phenolic, faced	25.0	25.0	CGSB51-GP-25

Note to Table 23J: (1) See 28E (4) to 28E (6)

(3) NBC Gypsum board, rigid insulation and fibreboard shall not be used for the attachment of cladding materials. Nails shall be not less than 3.2 mm in diameter with a mimimum head diameter of 11 mm.

(4) Lumber wall sheathing shall be applied so that all ends are supported with end joints staggered.

(5) Panel-type sheathing board shall be applied so that vertical joints are staggered if the sheathing is applied horizontally. A gap of not less than 2 mm shall be left between sheets of plywood, waferboard or fibreboard.

(6) NBC Where the bottom portions of mansard type roofs are vented, the vertical framing members behind the sloping portions shall be considered on the same basis as exterior wall studs and shall conform to the appropriate requirements in Subsection 23Q.

Q. WALL SHEATHING MEMBRANES

(1) NBC Sheathing membranes shall conform to CAN2-5.1.32, "Sheathing, Membrane, Breather Type."

(2) NBC Tar-saturated felts or papers shall not be used as a sheathing paper beneath stucco.

(3) NBC Except as provided in (5) and (6), at least 1 layer of sheathing membrane shall be applied beneath cladding, stucco or masonry veneer.

(4) NBC Sheathing membrane shall be applied so that joints are lapped at least 100 mm, and if applied horizontally, the upper sheets shall overlap the lower sheets.

(5) NBC Except as provided in (6), where no sheathing is used with masonry veneer or other cladding, at least 2 layers of sheathing membrane shall be applied beneath the veneer or cladding. All joints in the sheathing membrane shall occur over framing, and the membrane shall be fastened to the framing with roofing nails or staples spaced not more than 150 mm along the edges of the outer layer of sheathing membrane. Wall sheathing may be used in lieu of 1 layer of sheathing membrane, and the thickness need not conform to Table 23J.

(6) Sheathing membrane may be omitted beneath cladding when the joints in the cladding are formed to effectively prevent the passage of wind and rain in conformance with (7) or (8), as applicable.

(7) Siding consisting of sheets of plywood, hardboard, waferboard or asbestos cement is considered to meet the requirements of (6) provided the cladding is applied so that all edges are directly supported by framing and the vertical joints between adjacent sheets covered with battens or shiplapped or otherwise matched to provide weather tight joints. Vertical joints between sheets shall be caulked.

(8) Metal siding consisting of sheets of metal are considered to meet the requirements of (6) where the joints between sheets are of the locked seam type.

R. BRACING

(1) NBC Except as provided in (2), each exterior wall in each storey shall be braced with at least 1 diagonal brace conforming to (3), or by other acceptable means.

(2) NBC Bracing is not required where walls have an interior finish conforming to the requirements in Section 30, or if the walls are clad with panel type cladding, diagonal lumber, plywood, waferboard, gypsum board, or fibreboard sheathing.

(3) Where bracing is required, it shall consist of at least 19 mm by 89 mm wood members applied diagonally to the studs at an angle of approximately 45° to the horizontal extending the full height of the wall on each storey. Such bracing shall be nailed to each stud and wall plate by at least two 63 mm nails.

S. ALTERNATIVE FRAMING

Trussed or composite beams, joists, or studs may be used for framing provided that they are designed in accordance with good engineering practice.

SECTION 24: POST AND BEAM, PLANK FRAME AND LOG WALL CONSTRUCTION

A. SCOPE

(1) Subsections (B) to (F) of this Section apply to post and beam and plank wood-frame construction with the framing members spaced more than 600 mm apart.

(2) Subsection G applies to log wall construction.

B. GENERAL

(1) The size and spacing of posts and beams and the span and thickness of floor and roof-decking shall be calculated in conformance with Section 4.3 of the NBC except when specific dimensions are provided in this Section.

(2) Requirements for nails, lumber, notching and drilling, anchorage and sill plates shall conform to Section 23.

(3) Lumber shall conform to the appropriate requirements in Subsection 3C.

(4) NBC Buildings of post and beam construction not exceeding 1 storey in building height in seismic zone 3, not exceeding 2 storeys in seismic zone 2, and not exceeding 3 storeys in seismic zone 1, need not be designed to conform with the earthquake loading provision of Subsection 4.1 of the NBC.

C. DECKING

(1) Floor and roof decking shall consist of not less than 38 mm lumber laid on the flat or on edge or exterior type plywood conforming to CSA 0121, "Douglas Fir Plywood," CSA 0151, "Canadian Softwood Plywood" or CSA 0153, "Poplar Plywood" or waferboard conforming to CAN3-0188.2, "Waferboard."

(2) Plank floor decking laid on the flat shall not be more than 200 mm wide. Such decking shall be tongue-and-grooved or splined, unless a separate underlay is installed or the flooring consists of wood strips laid at right angles to the decking.

D. LOADBEARING BEAMS

(1) Loadbearing beams shall conform to Subsection 23H, and shall be solid, built-up, glued-laminated or plywood web beams. Where glued assemblies extend to the exterior, waterproof glue shall be used, except that water-resistant glue may be used where the exposed portion is adequately protected against wetting.

(2) Loadbearing roof beams shall be securely connected to the exterior wall framing and the centre loadbearing wall or centre beams to resist adequately the uplift forces due to wind.

(3) The length of end bearings for loadbearing beams shall be determined on the basis of the allowable design stress of the wood but shall not be less than 38 mm.

(4) When loadbearing beams are supported by mechanical connectors, the connectors shall be capable of supporting the design loads.

(5) Where joints in loadbearing beams do not occur over solid supports, joints shall be designed in conformance with Part 4 of the NBC. [See Subsection 23(H)]

(6) Opposing loadbearing beams shall be tied together at the joints by means of splices or suitable mechanical connectors. [See Subsection 23(H)]

(7) Where secondary framing members span between floor beams, the members and connections shall be designed to support the required design loads.

(8) Loads from loadbearing walls, columns or other concentrated loads shall be supported by framing members designed to carry such loads.

E. POSTS

(1) Posts shall be solid, built-up or laminated.

(2) Where wall sheathing does not provide suitable anchorage, exterior wall posts shall be anchored to the wall plate by not less than 1.19 mm thick steel angles.

(3) Solid posts and individual members in built-up posts shall extend in 1 piece the full height of the wall storey. Built-up members shall be fastened together with nails spaced not more than 300 mm o.c. and at least twice as long as the individual member thickness or with not less than 9.5 mm diameter bolts fitted with washers and spaced not more than 450 mm o.c.

(4) Intermediate studs or blocking shall be provided between posts in post and beam walls for the support of exterior and interior cladding. Intermediate studs shall conform to Section 23 for non-loadbearing stud walls.

F. PLANK FRAME WALL CONSTRUCTION

(1) Thickness of plank framing in plank frame walls shall conform to Table 24K. The unsupported height of 38 mm vertical plank non-loadbearing partitions shall not exceed 3.6 m.

TABLE 24K - NOMINAL THICKNESS OF PLANK FRAMING

Supported Load (Including dead load and ceiling)	Minimum Plank Thickness, mm
Roof with or without attic storage	38
Roof with or without attic storage, plus 1 floor	38
Roof with or without attic storage, plus 2 floors	64

(2) Vertical framing in plank frame walls consist of not less than 250 mm wide planks spaced not more than 2.4 m o.c.

(3) Vertical framing in plank frame walls shall not bear on wood members with the grain at right angles to the vertical framing, except where bearing on sills.

(4) Corners of plank walls shall be formed by butting and fastening together the face and edge of 2 planks.

(5) Vertical framing in plank frame walls shall be provided on each side of every opening, except that a window opening not more than 750 mm in width may be supported on 1 side only by a vertical member. In such cases the opposite jamb of the window or short upright to which it is attached shall bear on the filler wall plank immediately below, which in turn shall be notched into the vertical structural members on each side.

(6) Where horizontal planks act as loadbearing lintels or headers, they shall be framed into the vertical members by dovetailing so that not less than a 40 mm length of bearing is provided.

TABLE 24L - LINTEL SPANS

Nominal Lintel Size, mm	Maximum Span, m
38 x 184	1.55
38 x 235	1.96
38 x 286	2.23
64 x 184	1.96
64 x 235	2.23

(7) Openings in loadbearing plank frame walls shall be bridged with lintels designed to carry superimposed loads to adjacent vertical members.

(8) Where the spans of supported joists do not exceed 4.9 m and the spans of trusses do not exceed 9.8 m, the spans for wood lintels shown in Table 24L may be used for plank frame walls.

(9) Non-loadbearing horizontal members (fillers) in plank frame walls shall be securely fastened to the vertical framing.

(10) Sheathing membranes for plank frame walls shall be installed over the exterior of the planks when no sheathing is provided, or over the sheathing when sheathing is provided. (see Subsection 26D).

(11) Sheathing membranes shall conform to the requirements in Section 23.

G. LOG WALL CONSTRUCTION

NOTE: THIS SUBSECTION TO BE ADDED IN THE FUTURE

SECTION 25. SHEET STEEL STUD WALL FRAMING

A. GENERAL

(1) Except as modified in this Section, the requirements for wood frame walls as contained in Section 23 shall apply.

(2) This Section applies to sheet steel studs for use in non-loadbearing exterior and interior walls.

(3) Where loadbearing steel studs are used, they shall be designed in conformance with Part 4 of NBC.

(4) NBC Steel studs and runners shall conform to CGSB 7-GP, "Stud, Framing Member, Light Steel and Furring Channel, Rigid".

(5) Screws for the application of cladding materials to steel studs, runners and furring channels shall conform to ASTM C646, "Steel Drill Screws for the Application of Gypsum Sheet Material to Light Gauge Steel Studs."

(6) NBC Steel stud framing shall have cladding on both sides, fastened with screws or other acceptable fasteners at the appropriate spacing as described in Section 30, penetrating at least 10 mm through the metal.

(7) For requirements to mitigate the effects of thermal bridging, see Sub-section 26C.

B. SIZE OF FRAMING

(1) Except as required in (3) and (4), the size and spacing of steel studs for non-loadbearing interior walls shall conform to Table 25A.

(2) Except as required in (4), steel studs in non-loadbearing interior walls shall have a metal thickness of not less than 0.50 mm.

(3) Runners for interior and exterior non-loadbearing walls shall have a thickness of at least 0.45 mm exclusive of coatings and shall have at least 25 mm flanges.

TABLE 25A - STEEL STUDS FOR NON-LOADBEARING INTERIOR WALLS

Minimum Stud Size, mm	Maximum Stud Spacing mm	Maximum Wall Height m
31 x 40	400 600	3.0 2.7
31 x 63	400 600	4.0 3.6
31 x 91	400 600	5.2 4.9

(4) Where openings for doors in non-loadbearing fire separations required to have a fire-resistance rating do not exceed 1,200 mm in width, the steel studs shall be at least 63 mm wide, and have a metal thickness of at least 0.50 mm. Where openings exceed 1,200 mm in width, the stud width shall be at least 91 mm, and shall have a metal thickness shall be at least 0.85 mm.

(5) The distance to the first stud beyond the jamb of any door opening in a fire separation required to have a fire-resistance rating shall not exceed 400 mm. Where the distance between the framing over the opening and the top runner exceeds 400 mm in such walls, intermediate support shall be installed at intervals of not more than 400 mm above the opening.

(6) The size and spacing of non-loadbearing steel studs for exterior walls shall conform to Table 25B.

TABLE 25B - STEEL STUDS FOR NON-LOADBEARING EXTERIOR WALLS

Minimum Stud Size, mm	Minimum Metal Thickness, mm (excluding coating)	Maximum Stud Length, m		
		Spacing of Studs		
		300 mm (o.c.)	400 mm (o.c.)	600 mm (o.c.)
31 x 91	0.53	3.0	2.4	—
31 x 91	0.69	3.3	2.7	2.4
31 x 91	0.85	3.6	3.0	2.7
31 x 91	1.0	4.0	3.3	3.0

C. INSTALLATION

(1) Runners shall be provided at the top and bottom of walls. Such runners shall be securely attached to the building at approximately 50 mm from the ends, and at intervals of not more than 600 mm o.c. for interior walls and 300 mm o.c. for exterior walls. Such fasteners shall consist of the equivalent of 63 mm nails or 25 mm screws.

NBC

(2) Studs at openings and which are not full wall height shall be supported by a runner at the ends of the studs, securely fastened to the full length studs at the sides of the opening.

(3) Steel studs used in walls required to have a fire-resistance rating shall be installed so that there is at least a 12 mm clearance between the top of the stud and the top of the runner to allow for expansion in the event of fire. Except as provided in (8), studs in such walls shall not be attached to the runners in a manner that will prevent such expansion.

(4) Framing above doors in non-loadbearing fire separations required to have a fire-resistance rating shall consist of 2 runners on the flat fastened back to back. The upper runner shall be bent at each end to extend upwards at least 150 mm and fastened to the adjacent studs. A gypsum board filler piece, the width and length of the runner, shall be provided between the door frame and the adjacent runner.

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(5) Steel studs shall be installed with webs at right angles to the wall face and, except at openings, shall be continuous for the full wall height.

(6) Corners and intersections of walls and partitions shall be constructed to provide support for the cladding materials.

(7) Studs shall be doubled on each side of every opening where such openings involve more than 1 stud space and shall be tripled where the openings in exterior walls exceed 2.4 m in width. Such studs shall be suitably tied together to act as a single structural unit in resisting transverse loads.

(8) Studs shall be attached to runners by screws, crimping, welding or other suitable method around wall openings, and elsewhere where necessary to keep the studs in alignment during construction.

(9) NBC Openings for fire dampers in non-loadbearing fire separations required to have a fire-resistance rating shall be framed with double studs on each side of the opening. The sill and header shall consist of a runner track with right angle bends made on each end so as to extend 300 mm above the header or below the sill and fastened to the studs. The openings so formed shall be lined with a layer of gypsum board at least 12.7 mm thick, fastened to stud and runner webs.

SECTION 26
THERMAL INSULATION AND THE PREVENTION OF CONCEALED CONDENSATION

A. SCOPE

(1) This Section applies to buildings of residential occupancy intended for use on a continuing basis during the heating season.

(2) Except for B(8), the authority having jurisdiction may permit deviations from the requirements of this Section where it can be shown that the deviations will not result in a use of energy that is greater than would result from following the requirements of these Standards, and will not result in an increased risk of condensation.

B. THERMAL RESISTANCE OF BUILDING ASSEMBLIES

(1) Calculations for heat losses and gains and for the thermal resistance of building assemblies shall be made in conformance with good engineering practice and data such as are available in ASHRAE handbooks, the HRAI Digest, HI Manuals. Thermal resistance values for materials may be obtained from CMHC Evaluation reports.

(2) Except as provided in (3) and (5), and except for doors, windows, skylights and other closures, or a concrete or masonry foundation wall assembly separating heated space from unheated space or the outdoors, the minimum thermal resistance of a building assembly more than 250 mm above ground, as calculated through any section that does not include framing or furring members, shall be determined in conformance with Table 26 A.

TABLE 26A

MINIMUM THERMAL RESISTANCE (RSI) REQUIRED FOR BUILDING ASSEMBLIES MORE THAN 250 MM ABOVE GROUND

DEGREE DAYS	6500	8000	9500	11000	12500
MINIMUM RSI	5.61	6.22	6.78	7.30	7.78

Notes for Table 26A:

(1) RSI values may be interpolated or extrapolated for other Degree-Day values.

(2) Degree Days means the annual number of celsius degree days below 18°C

(3) The values in Table 26A are derived from the formula given in (3), on the assumption that, at any given location, the cost of adding insulation (B) is 10 times the cost of a litre of heating oil (C).

(3) In place of the values in Table 26 A, the authority having jurisdiction may determine the minimum thermal resistance, as defined in (2), by means of the following formula (see Appendix):

$$RSI = 0.22\sqrt{\frac{DC}{B}}$$

Where B = cost per square metre of building assembly for each increment in RSI value in cents, as determined by the authority having jurisdiction.

C = cost of one litre of heating oil, in cents, as determined by the authority having jurisdiction (irrespective of the type of fuel which will actually be used to heat the building).

D = annual number of celsius degree days below 18°C

(4) Except as provided in (5), and except for doors, windows and other closures, the minimum thermal resistance of foundation wall assemblies separating heated space from unheated space, the outdoors or the surrounding soil, as calculated through any section that does not include framing or furring members, shall be determined in conformance with Table 26 B.

TABLE 26B

MINIMUM THERMAL RESISTANCE REQUIRED FOR FOUNDATION WALL ASSEMBLIES, RSI

		Degree Days (b)				
		6500	8000	9500	11000	12500
Concrete or masonry foundation wall having less than 50% of its wall face exposed to outdoor air	Portion of wall more than 250 mm above ground level (a)	2.80	3.11	3.39	3.65	3.89
	Portion of wall below ground or less than 250 mm above ground	1.75				
Concrete or masonry foundation wall having more than 50% of its wall face exposed to outdoor air	Portion of wall more than 250 mm above ground level	conform to (2) or (3)				
	Portion of wall below ground or less than 250 mm above ground	1.75				
Foundation wall assemblies other than concrete or masonry	Portion of wall more than 250 mm above ground level	conform to (2) or (3)				
	Portion of wall below ground or less than 250 mm above ground	1.75				

Notes for Table 26B:

(a) RSI values may be interpolated or extrapolated for other Degree-Day values.

(b) Degree Days means the annual number of celsius degree-days below 18°C

(5) The thermal resistance of any building assembly may be reduced from that required in (2), (3), or (4), and the area of glazing may be increased above the maximum specified in Subsection 7B, provided that the thermal resistance of other assemblies of the building is increased so that the total calculated heat loss from the building envelope does not exceed the heat loss that would result if the enclosure were constructed in conformance with the minimum thermal resistance requirements of (2), (3), (4) and Subsections 6E and 7B.

(6) Notwithstanding the provisions of (2), (3) or (5), the thermal resistance of any building assembly more than 250 mm above ground separating heated from unheated space or the outdoors, except for concrete or masonry foundation walls, and excluding doors, windows or other closures, shall not be less than RSI 5.0.

(7) No building assembly shall have its thermal resistance reduced on account of the provision of other mechanical features, such as heat recovery devices or high-efficiency heating equipment.

(8) For roof or ceiling assemblies separating heated spaces from unheated space or the outdoors, the thermal resistance values required by (2), (3) or (5) may be reduced near the eaves to the extent made necessary by the roof slope, except that it shall not be less than the thermal resistance required for the wall below.

(9) Insulation of air intake and exhaust ducts shall conform to 33E(5) and 33E(6).

(10) Plumbing stacks shall be insulated to the requirement of Subsection 32(G).

(11) The thermal resistance of glazing shall conform to Subsections 6F and 7B.

(12) The thermal resistance of doors shall conform to Subsection 6E.

(13) The thermal resistance of vent closures shall conform to 33C(3).

(14) Supply and return ducts that circulate heated air or cooled air and that are located outside the building envelope shall have all joints sealed with mastic or tape, and shall be insulated as required in B(2) or B(3) for building assemblies above ground, adjusted to account for any greater temperature differential between the air temperature in the duct and outdoor temperatures.

C. MEASURES TO PREVENT AIR LEAKAGE AND CONDENSATION

(1) The building envelope shall be constructed with an air-vapour barrier, installed in conformance with this Subsection.

(2) Other than for fire separations, where an interior wall meets the components of a building envelope required to have air-vapour barrier protection, the air-vapour barrier shall provide unbroken protection against air and vapour movement between the interior wall and the envelope.

(3) Where a fire separation penetrates to the outside, its extremities shall be insulated as required in Subsection B and shall be protected from wind-induced air flow and the entry of water from the outdoors (See also Subsection D)

(4) The air-vapour barrier shall have sufficient strength of itself or shall be supported and fastened so as to have sufficient strength to withstand the design wind load.

(5) Where wires, pipes, ducts or chimneys penetrate the air-vapour barrier, they shall be held rigidly at such points of penetration so that the integrity of the air-vapour barrier is maintained. (See Section 21 for fire separation requirements around chimneys).

(6) All joints in an air-vapour barrier shall be sealed, and the air-vapour barrier shall be sealed to all window and door frames.

(7) Where a duct passes through insulation it shall be made from one piece of ducting and any longitudinal seams shall be sealed with duct tape.

(8) The thermal resistance of that portion of a building assembly on the warm side of the air-vapour barrier required by (1) shall not be more than:

a) 25% of the total designed thermal resistance of the building assembly, when the 2 1/2% January design temperature at the building site is not colder than -35°C,

b) 20% when the 2 1/2% January design temperature is -50°C or colder.

c) a value interpolated between 20% and 25% when the 2 1/2% January design temperature is between -35°C and -50°C.

(9) A building envelope incorporating metal framing elements that may act as a thermal bridge shall be insulated to restrict heat flow through the thermal bridge by a material providing a thermal resistance equal to at least 25 percent of the thermal resistance required for the insulated portion of the envelope in B(2) or B(3), unless it can be shown that the heat flow through the thermal bridge is not greater than the heat flow through a wood frame assembly of the same thickness.

(10) Where an air barrier is installed, it shall conform to the requirements for installing an air-vapour barrier in (2), (5) and (6).

D. INSTALLATION OF INSULATION

(1) Insulation shall be installed so that there is no air space between it and the air-vapour barrier.

(2) Except for ceiling insulation in attics, ventilated roof spaces and in fire separations, air-permeable insulation shall fill the cavity in which it is installed.

(3) Insulation shall be installed without any air spaces or pockets throughout its thickness.

(4) Except as permitted in B(8), insulation shall be installed so that the the required thermal performance is obtained over the entire face of the insulated area of the building assembly.

(5) Loose fill insulation may only be used on surfaces having a slope of less than 1 in 6.

(6) Except for treated wood or steel foundation walls, insulation with a thermal resistance of at least RSI 1.75 shall be applied on the exterior of the foundation walls and carried down to the level of the basement floor.

(7) A concrete or masonry foundation wall having more than 50% of its wall face exposed to outdoor air shall, for that portion of the wall more than 250 mm above ground, have the additional thermal resistance required by Table 26B applied on the exterior face. A concrete or masonry wall having less than 50% of its wall face exposed to outdoor air may have the additional thermal resistance applied on the exterior or interior face.

(8) Foam insulation required in Subsection 16F for slabs on permafrost shall conform to CGSB 41-GP-14a, "Thermal Insulation, Expanded, Polystyrene Q", Type 4 (Minimum compressive stress of 240 kPa) and shall be bedded over a smoothed layer of cement mortar (1:6 mix of cement to sand) or over a smooth layer of sand (2mm sieve).

(9) Where insulation on a foundation wall may be exposed to weather or subject to mechanical damage, it shall be protected with not less than 6 mm asbestos cement board, 12 mm cement parging on stucco lath for vertical surfaces, as specified in Table 29B, or other acceptable material applied to the exposed faces and edges.

(10) Where insulation is located in an area not exposed to weather but where it may be subject to mechanical damage, such as on walls of rooms, basements, cellars and garages, it shall be protected by a suitable covering, such as gypsum board, plywood, particleboard, waferboard or hardboard.

(11) Insulation in factory-built buildings and components shall be installed so that it will not become dislodged during transportation.

(12) Air-permeable insulation in ventilated attics and roof spaces shall have exposed edges protected by a covering impervious to wind and water, secured in place against being dislodged by wind, and sealed to the supporting members. The top surface of insulation within 1 m of the end of the insulation adjacent to a vent, which is provided in conformance with Subsection 19B, shall be covered by a material impervious to wind and water secured in place against being dislodged.

(13) The exterior face of wall insulation shall be protected from wind induced air flow and the entry of water from the outdoors by a weather barrier that shall:

(a) be impervious to wind,
(b) have a vapour permeance conforming to CAN 2-51.32, "Sheathing Membrane, Breather Type",
(c) completely cover the exterior of the insulation and wall framing members,
(d) be installed so as to be capable of withstanding the design wind load,
(e) be installed so as to shed water to the outside by gravity,
(f) be sealed on all edges, to the sides of all penetrations and at all overlaps with a compatible, waterproof, flexible sealing compound conforming to Subsection 28D, or by other acceptable means, and
(g) have overlaps sealed and fastened to a solid backing to prevent the entry of wind and moisture, where flexible materials are used.

(14) Insulation in floors shall have its outer face protected by a weather barrier that shall:

(a) be impervious to wind,
(b) have a vapour permeance conforming to CAN 2-51.32, "Sheathing Membrane, Breather Type",
(c) be installed so as to be capable of withstanding the design wind load,
(d) be sealed on all edges, to the sides of all penetrations and at all overlaps with a compatible, waterproof, flexible sealing compound conforming to Subsection 28D, or by other acceptable means, and
(e) have overlaps sealed and fastened to a solid backing to prevent the entry of wind and moisture, where flexible materials are used.

E. TESTS AND MATERIALS

(1) The building envelope shall have an equivalent leakage area not greater than 170 mm^2 per 1 m^2 of envelope area if tested on or before completion in conformity with CAN2-149.10-M, "Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method".

(2) Insulation in contact with the ground shall be inert to the action of soil and water. The insulation properties shall not be significantly reduced by moisture or by compression resulting from soil pressure.

(3) Type I expanded polystyrene insulation as described in CGSB 51-GP-20M, "Thermal Insulation, Expanded Polystrene" shall not be used in contact with the ground or as roof insulation applied above the roofing membrane.

(4) Insulating materials shall conform to one or more of the following, except that the flame-spread ratings contained in these Standards shall not apply (see NBC 9.26.3.3):
CAN 2.51.28, "Thermal Insulation, Vermiculite, Loose Fill",
CSA A101, "Mineral Fibre Thermal Building Insulation,"
CSA A247, "Insulating Fibreboard Sheathing,"
CGSB 51-GP-20M, "Thermal Insulation, Expanded Polystyrene,"
CGSB 51-GP-21M, "Thermal Insulation, Urethane and Isocyanurate, Unfaced",
CAN 2.51.25, "Thermal Insulation, Phenolic, Faced",
NBC
CGSB 51-GP-27, "Thermal Insulation, Polystyrene, Loose Fill", or
CAN 2.51.60, "Thermal Insulation, Cellulose Fibre, Loose Fill".

(5) Air-vapour barriers including liquid-applied coatings shall be equivalent to a Type 1 vapour barrier conforming to CAN 2-51.33, "Vapour Barrier, Sheet, for Use in Building Construction."

(6) Where film or sheet material is used as an air-vapour barrier it shall have a minimum thickness of 0.15 mm.

(7) Sealants used with air-vapour barriers and weather barriers shall be compatible with the materials with which they are in contact, and shall be suitable for their intended purpose. (See also Subsection 28D)

SECTION 27. ROOFING

A. GENERAL

(1) This Section applies to all buildings, regardless of size.

(2) Roofs shall be protected with roofing, including flashing, installed to shed rain effectively and prevent water due to ice damming from entering the roof.

B. MATERIALS

(1) Roofing materials shall conform to the following:

CAN2-51.32, "Sheathing, Membrane, Breather Type,"

CGSB 37-GP-4, "Cement, Lap, Cutback, Asphalt, Fibrated, for Asphalt Roofing,"

CGSB 37-GP-5, "Cement, Plastic, Cutback Asphalt,"

CGSB 37-GP-8, "Asphalt, Cutback, Filled, for Roof Coating,"

CGSB 37-GP-9, "Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing,"

CGSB 37-GP-21, "Tar, Cutback, Fibrated, for Roof Coating,"

NBC CGSB 41-GP-6, "Sheets, Thermosetting Polyester Plastics, Glass Fiber Reinforced,"

CSA A123.1, "Asphalt Shingles Surfaced with Mineral Granules,"

CSA A123.2, "Asphalt Coated Roofing Sheets",

CSA A123.3, "Asphalt or Tar Saturated Roofing Felt",

CSA A123.4, "Bitumen for Use in Construction of Built-Up Roof Coverings and Dampproofing and Waterproofing Systems",

CSA A123.17, "Asphalt-Saturated Felted Glass-Fibre Mat for Use in Construction of Built-Up Roofs," or

CSA 0118.1, "Western Red Cedar Shingles, Machine Grooved Shakes, and Handsplit Western Red Cedar Shakes."

(2) Nails used for roofing shall be corrosion-resistant roofing or shingle nails conforming to CSA B111, "Wire Nails, Spikes and Staples." Nails shall have sufficient length to penetrate through or 12 mm into roof sheathing. Nails used with asphalt roofing shall have a head diameter of not less than 9.5 mm and a shank thickness of not less than 2.95 mm. Nails used with wood shingles or shakes shall have a head diameter of not less than 4.8 mm and a shank thickness of not less than 2.0 mm and shall be stainless steel, aluminum or hot-dipped galvanized.

(3) Staples used to apply asphalt or wood shingles shall be corrosion-resistant and shall be driven with the crown parallel to the eaves. Staples used with asphalt shingles shall be not less than 19 mm long, 1.6 mm diameter or thickness, with not less than a 25 mm crown, except that an 11 mm crown may be used if the number of staples specified in G(4) is increased by 1/3. Staples used with wood shingles shall be not less than 29 mm long, 1.6 mm diameter or thickness, with not less than a 9.5 mm crown and shall be stainless steel or aluminum.

C. ROOF SLOPE

(1) Except as provided in (2), the roof slopes on which roof coverings may be applied shall conform to Table 27A.

(2) Asphalt and gravel or coal tar and gravel roofs may be constructed with lower slopes than required in (1) when effective drainage is provided by roof drains located at the lowest points on the roofs.

D. FLASHING AT INTERSECTIONS

(1) NBC Sheet metal flashing shall consist of not less than 1.73 mm thick sheet lead, 0.33 mm thick galvanized steel, 0.46 mm thick copper, 0.46 mm thick zinc or 0.48 mm thick aluminum.

(2) Where sloping surfaces of shingled roofs intersect to form a valley, the valley shall be flashed. Closed valleys shall not be used with rigid shingles on slopes of less than 1 in 1.2.

(3) Open valleys shall be flashed with not less than 1 layer of sheet metal not less than 600 mm wide or 2 layers of roll roofing. The bottom layer shall consist of not less than Type S smooth surface roll roofing or Type M mineral surface roll roofing (mineral surface down) not less than 457 mm wide, centred in the valley and fastened with nails spaced not more than 450 mm o.c. located 25 mm away from the edges. The top layer shall consist of not less than Type M mineral surface roll roofing (mineral surface up), 914 mm wide, centred in the valley, applied over a 100 mm wide strip of cement along each edge of the bottom layer, and fastened with a sufficient number of nails to hold it in place until the shingles are applied.

TABLE 27A - ROOFING TYPES AND SLOPE LIMITS OF ROOFS

Type of Roofing	Minimum Slope	Maximum Slope
Built-up Roofing		
Asphalt base (gravelled)	1 in 50*	1 in 4
Asphalt base (without gravel)	1 in 25	1 in 2
Asphalt base (surfaced with wide selvage asphalt roofing)	1 in 6	no limit
Coal-tar base (gravelled)	1 in 50*	1 in 25
Cold process	1 in 25	1 in 1.33
Asphalt Shingles		
Normal application	1 in 3	no limit
Low slope application	1 in 6	no limit
Roll Roofing		
Smooth and mineral surfaced	1 in 4	no limit
480 mm wide selvage asphalt roofing	1 in 6	no limit
Cold application felt	1 in 50	1 in 1.33
Wood Shingles	1 in 4	no limit
Handsplit Shakes	1 in 3	no limit
Asbestos-Cement Corrugated Sheets	1 in 4	no limit
Corrugated Metal Roofing	1 in 4	no limit
Sheet Metal Shingles	1 in 4	no limit
Slate Shingles	1 in 2	no limit
Clay Tile	1 in 2	no limit
Glass Fibre Reinforced Polyester Roofing Panels	1 in 4	no limit

Note to Table 27A: * See 27C(2)

(4) The intersection of shingle roofs and masonry walls or chimneys shall be protected with flashing. Counter flashing embedded not less than 25 mm in the masonry shall extend not less than 150 mm down the masonry and lap the lower flashing not less than 100 mm. Flashing along the slopes of a roof shall be stepped so that there is not less than a 75 mm head lap in both the lower flashing and counter flashing. Where the roof slopes upwards from the masonry, the flashing shall extend up the roof slope to a point equal in height to the flashing on the masonry, but not less than 1 1/2 times the shingle exposure.

(5) The intersection of shingle roofs and walls clad with other than masonry shall be protected with flashing. Flashing shall be installed so that it extends up the wall not less than 75 mm behind the sheathing paper, and extends not less than 75 mm horizontally. Along the slope of the roof, the flashing shall be stepped with not less than a 75 mm head lap.

(6) The intersection of built-up roofs with masonry walls or chimneys shall have a cant strip at the intersection, and a roofing membrane shall be mopped over the cant strip and not less than 150 mm up the wall. Counter flashing installed over the intersection shall be embedded not less than 25 mm in the masonry and shall be of sufficient length to extend down not less than 150 mm, lapping the membrane on the masonry not less than 100 mm.

(7) The intersection of built-up roofs with walls clad with other than masonry shall have a cant strip at the intersection. The roofing membrane shall be mopped over the cant strip. Flashing piles shall extend not less than 150 mm up the wall behind the sheathing paper.

(8) Except as otherwise permitted in (9), chimney saddles shall be installed where the upper side of a chimney on a sloping roof is more than 750 mm wide. Chimney saddles shall be covered with sheet metal or roofing material of equivalent weight and quality as the roofing. Saddles shall be suitably flashed where they intersect the roof. The intersection of the saddle and the chimney shall be flashed and counter-flashed as in (4).

(9) A chimney saddle need not be installed if the intersection between the chimney and roof is protected by sheet metal flashing that extends up the chimney to a height equal to not less than 1/6 the width of the chimney, but not less than 150 mm, and up the roof slope to a point equal in height to the flashing on the chimney, but not less than 1 1/2 times the shingle exposure. Such flashing at the chimney shall be counterflashed as required by (4).

E. EAVE PROTECTION FOR SHINGLES AND SHAKES

(1) Except as provided in (3), eave protection shall be provided on shingle, shake or tile roofs extending from the edge of the roof a minimum distance of 914 mm up the roof slope to a line not less than 300 mm inside the inner face of the exterior wall.

(2) Eave protection shall be laid beneath the starter strip and shall consist of not less than 0.15 mm polyethylene laid as a continuous sheet without the use of cement, or No. 15 asphalt-saturated felt laid in two plies lapped 480 mm and cemented together with lap cement, or Type S smooth surface roll roofing. Roll roofing shall be laid with not less than 100 mm head and end laps cemented together with lap cement.

(3) Eave protection is not required over unheated garages, carports and porches, or where the roof overhang exceeds 900 mm measured along the roof slope from the edge of the roof to the inner face of the exterior wall, or where shingles for low slope roofs are used.

F. UNDERLAY BENEATH SHINGLES

(1) When underlay is used beneath shingles, it shall be asphalt-saturated sheathing paper weighing not less than 0.195 kg/m^2, or No. 15 plain or perforated asphalt-saturated felt or 0.05 mm polyethylene, except that underlayment used beneath wood shingles shall be breather type.

(2) When used with shingles, underlay shall be installed parallel to the eaves with head and end lap of not less than 50 mm. The top edge of each strip shall be fastened with sufficient roofing nails to hold it in place until the shingles are applied. The underlay shall overlap the eave protection by not less than 100 mm. (See J(2) for underlay beneath wood shakes).

G. ASPHALT SHINGLES ON SLOPES OF 1 IN 3 OR GREATER

(1) Coverage shall not be less than 2 thicknesses of shingle over the entire roof, disregarding cutouts.

(2) A starter strip shall be installed along the lower edge of the roof so that it extends approximately 12 mm beyond the eaves and rake of the roof and is fastened along the bottom edge with nails spaced not more than 300 mm o.c.. Such starter strips shall be not less than Type M mineral-surfaced roll roofing not less than 304 mm wide, or shingles of the same weight and quality as those used as a roof covering with tabs facing up the roof slope. Starter strips may be omitted where eave protection of not less than Type M mineral-surfaced roll roofing is provided.

(3) Shingles shall have a head lap of not less than 50 mm.

(4) Shingles shall be fastened with at least 4 nails or staples for 1 metre wide shingles so that no nails or staples are exposed. Fasteners may be reduced for narrower shingles in proportion to the width of the shingle or when shingles incorporating acceptable interlocking devices are used.

(5) Fasteners shall be located 25 mm to 40 mm from each end of each strip shingle with the other fasteners equally spaced between them. Such fasteners shall be located not less than 12 mm above the tops of the cutouts.

(6) Shingle tabs shall be secured by plastic cement under the centre of each tab, or by interlocking devices or selfsealing strips.

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(7) Shingles on hips and ridges shall be applied so they extend not less than 100 mm on either side of the hip or ridge and shall be lapped not less than 150 mm. Shingles shall be fastened with nails or staples on each side located not more than 25 mm from the edge and 25 mm above the butt of the overlying shingle.

(8) Eave protection shall conform to Subsection E.

(9) Flashing shall conform to Subsection D.

H. ASPHALT SHINGLES ON SLOPES OF LESS THAN 1 IN 3

(1) Except for the first 2 courses, coverage shall be not less than 3 thicknesses of shingle over the entire roof, disregarding cutouts.

(2) A starter strip shall be installed as in G(2). Such starter strip shall be laid in a continuous band of cement not less than 200 mm wide.

(3) Shingle tabs shall be secured with cold application cement applied at the rate of not less than 0.5 L/m^2 of cemented area, or hot application asphalt applied at the rate of 1 kg/m^2 of cemented area.

(4) The first course of shingles shall be secured by a continuous band of cement along the eaves applied so that the width of the band equals the shingle exposure plus 100 mm and the band is located not less than 50 mm above the lower edge of the starter strip.

(5) The succeeding courses of shingles shall be secured by a continuous band of cement applied so that the width of the band equals the shingle exposure plus 50 mm. Such band shall be located not less than 25 mm nor more than 50 mm above the butt of the overlying course of shingles.

(6) Shingles on hips and ridges shall be not less than 300 mm wide applied to provide triple coverage. Such shingles shall be cemented to the roof shingles and to each other with a coat of cement 25 mm from the edges of the shingles and fastened with nails or staples located 40 mm above the butt of the overlying shingle and 50 mm from each edge.

(7) Flashing shall conform to Subsection D.

(8) Shingles shall be fastened in accordance with G(4) and G(5).

I. WOOD ROOF SHINGLES

(1) Decking for wood shingled roofs may be continuous or spaced.

(2) Where underlayment is used beneath wood shingles it shall be of the breather type.

(3) Shingles shall be not less than No. 2 grade.

(4) Wood shingles shall be not less than 400 mm long and not less than 75 mm nor more than 350 mm wide.

(5) Shingles shall be spaced approximately 6 mm apart and offset at the joints in adjacent courses not less than 38 mm so that joints in alternate courses are staggered.

(6) Shingles shall be fastened with at least 2 nails or staples located approximately 19 mm from the sides of the shingle and 38 mm above the exposure line.

(7) The exposure of wood roof shingles shall conform to Table 27B.

TABLE 27B - EXPOSURE OF WOOD ROOF SHINGLES

Roof Slope	Maximum Single Exposure, mm					
	No. 1 Grade			No. 2 Grade		
	Length of Shingle			Length of Shingle		
	400 mm	450 mm	600 mm	400 mm	450 mm	600 mm
1 in 3 or less	95	105	145	90	100	140
over 1 in 3	125	140	190	100	115	165
Column 1	2	3	4	5	6	7

(8) Flashing shall conform to Subsection D.

(9) Eave protection shall conform to Subsection E.

J. HANDSPLIT ROOF SHAKES

(1) Shakes shall be not less than 450 mm long and not less than 100 mm nor more than 350 mm wide with a butt thickness of not more than 32 mm and not less than 9 mm.

(2) A breather-type underlay shall be provided beneath roof shakes. Underlay shall be laid as a strip not less than 900 mm wide along eaves and 300 mm wide along hips and ridges. Underlay shall be laid as a strip not less than 450 mm wide between each course of shakes with the bottom edge of the underlay positioned above the butt line a distance equal to double the exposure of the shakes.

(3) Shakes shall be spaced approximately 6 mm apart and offset at the joints in adjacent courses not less than 40 mm so that joints in alternate courses are staggered.

(4) Shakes shall be fastened with nails located approximately 20 mm from the sides of the shakes and 40 mm above the exposure line.

(5) The exposure of wood shakes shall not exceed 190 mm for shakes at least 450 mm long and 250 mm for shakes at least 600 mm long.

(6) Flashing shall conform to Subsection D.

(7) Eave protection shall conform to Subsection E.

K. BUILT-UP ROOFS

(1) The quantities of bituminous materials used on built-up roofs shall conform to Table 27D.

(2) Coal-tar products and asphalt products shall not be used together in built-up roof construction.

(3) Bitumen roofing felts shall be not less than No. 15 felt.

(4) Aggregate used for surfacing built-up roofs shall be clean, dry and durable and shall consist of particles of gravel, crushed stone or air-cooled blast furnace slag having a size of from 6 mm to 15 mm.

(5) Flashing shall conform to Subsection D.

TABLE 27D - QUANTITIES OF BITUMEN FOR BUILT-UP ROOFS

Type of Roof	Amount of Bitumen per Square Metre of Roof Surface	
	Mopping Coats Between Layers	Flood Coat
Asphalt and aggregate	1 kg	3 kg
Coal-tar and aggregate	1.2 kg	3.6 kg
Cold process roofing	0.75 L cold process cement	2 L cold process top coating

(6) The minimum amount of aggregate surfacing per square metre of roof surface shall be 15 kg gravel or crushed stone or 10 kg crushed slag.

(7) Built-up roofing shall consist of at least 3 mopped-down layers of roofing felt flood coated with bitumen.

(8) In hot-process applications each layer of bitumen-saturated felt shall be laid while the bitumen is hot, with each layer overlapping the previous one. The full width under each lap shall be coated with bitumen so that in no place does felt touch felt. Felt shall be laid free of wrinkles and shall be rolled directly into the hot bitumen and broomed forward and outward from the centre to ensure complete adhesion.

(9) Except as permitted in (10), built-up roofing applied over wood, plywood or waferboard roof sheathing shall be laid over an additional base layer of felt laid dry over the entire roof deck with at least a 50 mm headlap and a 50 mm sidelap between each sheet.

(10) Where plywood or waferboard roof sheathing is used, the dry layer of felt required in (9) may be omitted when the joints are taped and the sheathing is primed with asphalt.

(11) Roofing shall be securely attached to the decking or where insulation is applied above the deck, the insulation shall be securely attached to the deck before the first layer of felt is fastened to the insulation.

(12) Except as permitted in (13), a cant strip shall be provided at the edges of roofs. At least 2 plies of the roofing membrane shall be carried over the top of the cant strip. Flashing shall extend over the top of the cant strip and shaped to form a drip.

(13) The cant strip required in (12) may be omitted where a gravel stop is provided at the edge of roofs. The roofing membranes shall be carried over the edge of the roof before the gravel stop is fastened and 2 plies of roofing membrane mopped to the top surface of the gravel stop before the flood coat is applied. The gravel stop shall extend over the edge of the roof to form a drip or shall be flashed so that the flashing extends over the edge to form a drip.

L. SELVAGE ROOFING

(1) Wide selvage asphalt roofing shall provide double coverage over the entire roof surface.

(2) Plies of selvage roofing shall be cemented together to ensure a water tight joint.

M. SHEET METAL ROOFING

(1) Sheet metal roofing shall be not less than 0.33 mm thick galvanized steel, 0.35 mm thick copper, 0.46 mm thick zinc or 0.48 mm thick aluminum.

N. GLASS REINFORCED POLYESTER ROOFING

(1) Where glass reinforced polyester roofing panels are not supported by roof decking but span between spaced supports, the panels shall be designed to support the design roof load in conformance with good engineering practice.

O. DOWNSPOUTS AND ROOF DRAINS

(1) Where downspouts are provided and are not connected to a sewer, extensions shall be provided to carry rainwater away from the building in a manner which will prevent soil erosion.

(2) When roof drains are provided, thay shall conform to Part 7 of the NBC.

(3) Sheet metal eavestroughs shall be not less than 0.41 mm thick galvanized sheet steel, 0.43 mm thick copper or 0.51 mm thick aluminum. Sheet metal downspouts shall be not less than 0.36 mm thick galvanized sheet steel, 0.38 mm thick copper or 0.46 mm thick aluminum.

(4) Rigid poly vinyl chloride (PVC) eavestroughs shall be not less than 1.9 mm in thickness. PVC downspouts shall be not less than 1.8 mm in thickness.

(5) Wood gutters and downspouts shall be of durable species or treated with an acceptable wood preservative.

SECTION 28. SIDING

A. SCOPE

(1) This Section applies to all buildings, regardless of size.

(2) This Section applies to exterior wall coverings of lumber, wood shingles, shakes, asbestos-cement shingles and sheets, plywood, waferboard, hard-pressed fibreboard, asphalt shingles, vinyl, aluminum and steel including trim, soffits and flashings.

(3) Requirements for stucco shall conform to Section 29 and requirements for masonry veneer shall conform to Section 20.

(4) Where asphalt shingles are used as siding, they shall conform to the requirements in Section 27 for asphalt roof shingles.

(5) Spatial separations between buildings shall conform to the requirements of Subsection 10N.

B. GENERAL

(1) Exterior walls shall be protected with siding, including flashing, trim and other special-purpose accessory pieces required for the siding system being used, to restrict the entry of rain and snow into the wall assembly.

(2) Not less than a 200 mm clearance shall be provided between the finished ground level and siding that is adversely affected by moisture, such as wood, plywood, waferboard and hardboard.

(3) Not less than a 50 mm clearance shall be provided between a roof surface and siding that is adversely affected by moisture, such as wood, plywood, waferboard and hardboard.

(4) Insulating asphalt siding shall be ventilated by not less than a 10 mm air space behind the siding (See 26 C(4)).

(5) Insulation forming part of an applied siding shall not be considered to be part of the required insulation unless the conditions of Section 26 are met.

(6) Siding shall not be considered as a weather barrier unless specifically designed to meet the requirements of Section 26.

C. FLASHING

(1) Flashing shall consist of not less than 1.73 mm thick sheet lead, 0.33 mm thick galvanized steel, 0.46 mm thick copper, 0.46 mm thick zinc, 0.48 mm thick aluminum or 1.02 mm thick vinyl.

(2) Flashing shall be installed at every horizontal junction between 2 different exterior finishes, except where the upper finish overlaps the lower finish.

(3) Except as provided in (5), flashing shall be applied over exterior wall openings where the vertical distance from the bottom of the eave to the top of the trim is more than 1/4 of the horizontal overhang of the eave.

(4) Flashing shall be installed so that it extends upwards not less than 50 mm behind the sheathing paper and forms a drip on the outside edge.

(5) Where a window or exterior door is designed to be installed without head flashing, the exterior flange of the door or the window frame shall be bedded into a non-hardening type caulking material and the exterior flange screwed down over the caulking material to the wall framing, to form a waterproof joint.

D. CAULKING

(1) Caulking shall be provided where required to prevent the entry of water into the structure.

(2) Caulking shall be provided between masonry, siding or stucco and the adjacent door and window frames or trim, including sills unless such locations are completely protected from the entry of rain. Caulking shall also be provided at vertical joints between different siding materials unless the joint is suitably lapped or flashed to prevent the entry of rain. (See Articles 7 E(2), 20 O(3) and 29 A(6))

(3) Caulking shall be of a non-hardening type suitable for exterior use, selected for its ability to resist the effects of weathering and shall be compatible with and adhere to the substrate to which it is applied.

Caulking shall conform to one of the following:

CGSB 19-GP-5, "Sealing Compound, One Component, Acrylic Base, Solvent Curing."

CAN 2-19.13, "Sealing Compound, One Component, Elastomeric, Chemical Curing."

CGSB 19-GP-14, "Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing."

CGSB 19-24, "Sealing Compound, Multi-Component, Chemical Curing."

E. ATTACHMENT OF SIDING

(1) Except as permitted in (5) to (9), siding shall be nailed to the framing members, furring members or to blocking between the framing members.

(2) Blocking for the attachment of siding shall not be less than 38 mm by 38 mm lumber securely nailed to the framing and spaced not more than 600 mm o.c.

(3) Except as permitted in (8) and (9), furring for the attachment of siding shall be not less than 19 mm by 38 mm lumber when applied over sheathing. When applied without sheathing, such furring shall be not less than 19 mm by 64 mm lumber on supports spaced not more than 400 mm o.c. and 19 mm by 89 mm on supports spaced not more than 600 mm o.c. Such furring shall be securely fastened to the framing and shall be spaced not more than 600 mm o.c.

(4) NBC Vertical lumber and stucco lath or reinforcing may be attached to sheathing only where the sheathing consists of not less than 14.3 mm lumber, 12.5 plywood or 12.7 mm waferboard.

(5) Vertically applied metal siding and wood shingles may be attached to sheathing only, where the sheathing consists of not less than 14.3 mm lumber, 7.5 mm plywood or 7.9 mm waferboard.

(6) Asbestos-cement shingles may be attached to sheathing only, where the sheathing consists of not less than 14.3 mm lumber, 9.5 plywood or 11.1 mm waferboard.

(7) Where wood shingles or shakes are applied to sheathing which is not suitable for attaching the shingles or shakes, the shingles or shakes may be attached to a wood lath not less than 38 mm by 9.5 mm thick, securely nailed to the framing and applied as described in G(5).

(8) Where asbestos-cement shingles are applied to sheathing which is not suitable for attaching the shingles, the shingles may be attached to a wood lath not less than 89 mm by 9.5 mm thick, securely nailed to the framing. Such lath shall be applied so that it overlaps the preceding shingle course by not less than 20 mm.

(9) Nail or staple size and spacing for the attachment of siding and trim shall conform to Table 28A.

TABLE 28A - ATTACHMENT OF SIDING

Type of Siding	Min. Nail or Staple Length, mm	Min. no. of Nails or Staples	Maximum Nail or Staple Spacing
Wood trim	51	—	600 mm (o.c.)
Lumber siding or horizontal siding made from sheet material	51	—	600 mm (o.c.)
Metal or Vinyl Siding	38	—	600 mm (o.c.) nailed to framing 400 mm (o.c.) nailed to sheathing only
Handsplit wood shakes up to 200 mm in width	51	2	—
Handsplit wood shakes over 200 mm in width	51	3	—
Wood shingles and machine grooved shakes up to 200 mm in width	32	2	—
Wood shingles and machine grooved shakes over 200 mm in width	32	3	—
Asbestos-cement shingles	32	2	—
Panel or sheet type siding up to 7 mm thick	38	—	150 mm (o.c.) along edges
Panel or sheet type siding more than 7 mm thick	51	—	300 mm (o.c.) along intermediate supports

(10) Nails or staples for the attachments of siding and wood trim shall be corrosion-resistant and shall be compatible with the siding material. Fasteners for metal or vinyl siding shall be positioned to permit expansion and contraction of the siding.

(11) Fasteners for shakes and shingles shall penetrate through the nail-holding base or not less than 19 mm into the framing. Fasteners for other types of siding shall penetrate through the nail-holding base or not less than 25 mm into the framing.

F. LUMBER SIDING

(1) Lumber siding shall be sound, free of knots, loose holes, through checks or splits.

(2) Drop, rustic, novelty, lapped board and vertical wood siding shall be not less than 14.3 mm thick and not more than 286 mm wide.

(3) Bevel siding shall be not less than 5 mm thick at the top and 12 mm thick at the butt for sidings 184 mm or less in width, and 14.3 mm thick at the butt for sidings wider than 184 mm. Bevel siding shall be not more than 286 mm wide.

(4) Lumber siding shall prevent water from entering at the joints by the use of lapped or matched joints or by vertical wood battens. Siding shall overlap not less than 1 mm per 16 mm width of lumber, but not less than 9.5 mm for matched siding, 25 mm for lapped bevel siding or 12 mm for vertical battens.

G. WOOD SHINGLES AND MACHINE GROOVED SHAKES

NBC

(1) Shingles and shakes shall conform to CSA 0118.1, "Western Red Cedar Shingles, Handsplit Western Red Cedar Shakes and Machine Grooved Shakes". Shakes shall be not less than No. 1 grade and shingles not less than No. 2 grade, except that No. 3 grade may be used for undercoursing.

(2) Shingles and shakes shall be not less than 65 mm nor more than 350 mm wide.

(3) Shingles and shakes shall be fastened with nails located approximately 20 mm from each edge and not less than 25 mm above the exposure line for single-course applications, or approximately 50 mm above the butt for double-course applications.

(4) In single-course applications, joints in succeeding courses shall be offset at least 40 m, so that joints in any 2 of 3 consecutive courses are staggered. In double-course applications, joints in the outer course shall be offset from joints in the under-course by not less than 40 mm, and joints in succeeding courses shall be offset not less than 40 mm.

(5) When lath is used with double-course applications [See E(7)], it shall be spaced according to the exposure and securely fastened to the framing. The butts of the under-course shall rest on the top edge of the lath. The outer course shall be fastened to the lath with nails of sufficient length to penetrate through the lath. The butts of the shingles or shakes shall be so located that they project not less than 12 mm below the bottom edge of the lath. If wood lath is not used, the butts of the under-course shingles or shakes shall be located 12 mm above the butts of the outer course.

(6) The exposure and butt thickness of shingles and shakes shall conform to Table 28 B.

TABLE 28B - EXPOSURE AND THICKNESS OF WOOD SHINGLES AND MACHINE GROOVED SHAKES

Shake or Shingle Length, mm	Maximum Exposure		Minimum Butt Thickness, mm
	Single Coursing, mm	Double Coursing, mm	
400	190	305	10
450	216	356	11
600	292	406	13

H. ASBESTOS-CEMENT SHINGLES AND SHEETS

(1) Asbestos-cement shingles and sheets shall conform to one of the following:

CGSB 34-GP-4, "Siding: Asbestos Cement, Shingles and Clapboards",

CGSB 34-GP-5, "Sheets: Asbestos Cement, Corrugated",

CGSB 34-GP-14, "Sheets: Asbestos Cement, Decorative",

CAN2-34.16, "Sheets: Asbestos Cement, Flat, Fully Compressed",

CGSB 34-GP-17 "Sheets: Asbestos Cement, Flat, Semicompressed", or

CGSB 34-GP-21M, "Panels, Sandwich Asbestos Cement and Insulating Cores".

(2) Asbestos-cement shingles shall weigh not less than 8.06 kg/m^2. Asbestos-cement sheet shall be not less than 4.75 mm thick where applied to studs spaced not more than 400 mm o.c., nor less than 6 mm thick where applied to studs spaced not more than 600 mm o.c. Where applied over sheathing, thickness shall be not less than 3.15 mm.

(3) Asbestos-cement shingles shall be fastened with nails located not less than 25 mm above the exposure line.

(4) Asbestos-cement shingles shall be installed so that vertical joints in suceeding courses are staggered. Asphalt-coated backer strips shall be installed behind each vertical joint. Shingles shall have not less than a 25 mm head lap.

(5) Vertical joints of asbestos-cement panels shall be protected with batten strips, caulking or other suitable method.

(6) Horizontal joints shall be lapped, flashed, caulked or otherwise suitably protected.

I. PLYWOOD

(1) NBC Plywood siding shall be exterior type conforming to CSA 0115, "Hardwood and Decorative Plywood", CSA 0121, "Douglas Fir Plywood", CSA 0151, "Canadian Softwood Plywood" or CSA 0153, "Poplar Plywood".

(2) Plywood siding shall be not less than 6 mm thick when applied directly to the sheathing. When applied directly to the framing or over furring strips, plywood thickness shall conform to Table 28C. The thickness of grooved or textured plywood shall be measured at the point of least thickness.

TABLE 28C
MINIMUM PLYWOOD THICKNESS, EXTERIOR WALL FINISH

Spacing of Supports, mm	Face Grain Parallel to Supports, mm	Face Grain Right Angle to Supports, mm
400	8	6
600	11	8

(3) The edges of plywood siding shall be treated with a suitable paint or sealer.

(4) Plywood applied in panels shall have all edges supported. Not less than a 2 mm gap shall be provided between sheets. Vertical joints in such siding shall be protected with batten strips or caulking when the plywood joints are not matched. Horizontal joints shall be lapped not less than 25 mm or shall be suitably flashed.

(5) Plywood applied in horizontal lapped strips shall have not less than a 2 mm gap provided at the butted ends which shall be caulked. The horizontal joints shall be lapped not less than 25 mm. Wedges shall be inserted under all vertical butt joints and at all corners when horizontal lapped plywood is applied without sheathing.

J. HARDBOARD

(1) Factory-finished hardboard siding shall conform to CGSB 11-GP-5a, "Precoated Hardboard for Exterior Use". Hard-pressed fibreboard siding which is not factory finished shall conform to Types 1, 2 or 5 in CGSB 11-GP-3, "Hardboard".

(2) Type 1 or 2 hardboard siding shall be at least 6.0 mm thick when applied over sheathing that provides continuous support and at least 7.5 mm when applied to furring or framing members not more than 400 mm o.c. Type 5 hardboard siding shall be at least 9.0 mm thick when applied over sheathing that provides continuous support or over furring or framing members not more than 400 mm o.c. Where hardboard siding is grooved, the grooves shall not extend more than 1.5 mm into the required thickness.

NBC

(3) Hardboard siding applied in panels shall have all edges supported. Not less than a 5 mm gap shall be provided between sheets. Vertical joints in such siding shall be protected with batten strips or caulking when the joints are not matched. Horizontal joints shall be lapped not less than 25 mm or shall be suitably flashed.

(4) Hardboard applied in horizontal lapped strips shall have not less than a 5 mm gap provided at the butted ends which shall be caulked or otherwise protected with suitable mouldings. The horizontal joints shall be lapped not less than 25 mm.

(5) At least a 3 mm clearance shall be provided between hardboard siding and door or window frames.

K. WAFERBOARD

(1) Waferboard siding shall conform to CAN3-0188.2, "Waferboard".

(2) Waferboard shall be not less than 7.9 mm thick where applied directly to sheathing. Where applied directly to framing or over furring strips, waferboard shall be not less than 9.5 mm thick on supports spaced not more than 400 mm o.c. and 12.7 mm thick on supports spaced not more than 600 mm o.c.

(3) Waferboard applied in panels shall have all edges supported and treated with a primer or sealer. Not less than a 3 mm gap shall be provided between sheets. Vertical joints in such siding shall be protected with batten strips or caulking when the waferboard joints are not matched. Horizontal joints shall be lapped not less than 25 mm or shall be suitably flashed.

(4) At least a 3 mm clearance shall be provided between waferboard siding and door or window frames.

L. METAL SIDING

(1) NBC Horizontal and vertical strip steel siding, including flashing and trim accessories, shall conform to CGSB 93-GP-4, "Siding, Soffits and Fascia: Steel, (Galvanized), Prefinished, Residential".

(2) NBC Steel siding shall have a minimum thickness of 0.3 mm and conform to CGSB 93-GP-3, "Sheet Steel, Galvanized, Prefinished, Residential".

(3) NBC Horizontal and vertical strip aluminum siding, including flashing and trim accessories, shall conform to CGSB 93-GP-2, "Siding, Soffits and Fascia: Aluminum, Prefinished, Residential".

(4) NBC Aluminum sheet siding shall conform to CGSB 93-GP-1, "Sheet, Aluminum Alloy, Prefinished, Residential", and shall have a minimum thickness of 0.58 mm, except that siding supported by backing or sheathing shall have a minimum thickness of 0.46 mm.

M. VINYL SIDING

(1) Vinyl siding, including flashing and trim accessories, shall conform to CGSB 41-GP-24, "Siding, Soffits and Fascia, Rigid Vinyl".

(2) The attachment of vinyl siding shall conform to the requirements in Subsection E for metal siding.

(3) Vinyl siding shall be applied over sheathing or other backing that will provide continuous support for the siding.

N. EXTERIOR CEILINGS AND SOFFITS

(1) Where provided, ceilings for carports, galleries and porches and eave soffits shall be at least 9.5 mm lumber, 6 mm plywood, 6 mm hardboard or 3.2 mm asbestos-cement board on supports spaced not more than 600 mm o.c. Waferboard used for soffits shall be at least 7.9 mm thick on supports spaced not more than 400 mm o.c. and 9.5 mm thick for supports spaced not more than 600 mm o.c. Other acceptable material may also be used.

(2) Exterior ceilings and soffits shall be fastened with corrosion-resistant nails.

O. WOOD TRIM

(1) Exterior wood trim shall be one of the species mentioned in Clause 3.1.1 of CSA 0132.1, "Wood Windows". The defects in the lumber shall not exceed those permitted in Clause 3.2.1 of CSA 0132.1, "Wood Windows".

(2) Wood trim shall be fastened with corrosion-resistant casing or finishing nails.

SECTION 29. STUCCO

A. GENERAL

(1) This Section applies to all buildings, regardless of size.

(2) Sheathing shall be provided beneath stucco applied over wood-frame walls except as permitted in D(2). Where applied beneath stucco, sheathing shall conform to Subsection 23P.

(3) Stucco lath or reinforcing shall be used to attach stucco to wood-frame construction. Such lath or reinforcing shall also be used to attach stucco to masonry where the masonry is soft-burned tile or brick of less strength than the stucco or if the masonry surface is not sound, clean and sufficiently rough to provide a good key. Stucco applied over masonry chimneys shall be reinforced.

(4) Stucco finish shall not be applied over concrete masonry units less than 1 month old unless the units have been cured by the autoclave process.

(5) Stucco shall be not less than 200 mm above finished ground level except when it is applied over concrete or masonry.

(6) Flashing and caulking used with stucco shall conform to Subsections 28C and 28D, except that if aluminum flashing is used, it shall be separated from the stucco by an impervious membrane or coating. (See 7D(2) for caulking around window frames.)

B. STUCCO MATERIALS

(1) Portland cement shall conform to CAN3-A5,"Portland Cements."

(2) Aggregate shall be clean, well-graded, natural sand or sand manufactured from crushed stone, gravel or air-cooled blast furnace slag and shall contain no significant amounts of deleterious material. Aggregate grading shall conform to Table 29A.

(3) Hydrated lime shall conform to CSA A82.44, "Normal Finishing Hydrated Lime".

(4) Water shall be clean and free of significant amounts of deleterious material.

TABLE 29A: AGGREGATE GRADING FOR STUCCO

Sieve Sizes, mm	Per Cent Passing	
	Maximum	Minimum
4	--	100
2	--	90
1	90	60
0.5	60	45
0.25	30	10
0.125	5	--

C. FASTENERS

(1) Fasteners for stucco lath or reinforcing shall be corrosion-resistant and of a material other than aluminum.

(2) Nails for stucco lath or reinforcing shall be not less than 3.2 mm diameter with a head diameter of not less than 11.1 mm. Staples shall be not less than 1.98 mm diameter or thickness.

(3) Staples and nails for attaching stucco lath or reinforcing to vertical surfaces shall be of sufficient length to penetrate 25 mm into framing members or to the full depth of the sheathing where the sheathing is used for attachment. On horizontal surfaces nails shall be not less than 38 mm long.

D. STUCCO LATH

(1) Rib lath or expanded metal stucco mesh shall be copper-alloy steel coated with rust-inhibitive paint after fabrication or shall be galvanized. Woven or welded wire mesh shall be galvanized.

(2) NBC Sheathing need not be provided beneath stucco where not less than 1.19 mm diam galvanized wire is applied horizontally to the framing at vertical intervals not exceeding 150 mm, or where paper-backed welded wire metal lath is used.

(3) Stucco lath shall conform to Table 29B.

(4) Stucco lath shall be held not less than 6 mm away from the backing by means of suitable self-furring devices.

(5) Stucco lath shall be applied with the long dimension horizontal. Horizontal and vertical joints shall be lapped not less than 50 mm. End joints shall be staggered and shall occur over framing members. External corners shall be reinforced with a vertical strip of lath or reinforcing extending not less than 150 mm on both sides of the corner, or the lath or reinforcing shall extend around corners not less than 150 mm.

(6) Stucco lath shall be fastened in conformance with Subsection 28E.

(7) Fasteners on vertical surfaces shall be spaced not more than 150 mm o.c. vertically and 600 mm o.c. horizontally. Other nailing patterns may be used provided there are not fewer than 20 fasteners per square metre of wall surface.

TABLE 29B: STUCCO LATH

Location	Type of Lath	Min. Diam of Wire, mm	Max. Mesh Opening	Min. Mass, kg/m^2
Vertical surfaces	Welded or woven wire	1.19	25 mm	—
		1.35	38 mm	—
		1.60	51 mm	—
	Stucco mesh reinforcing (expanded metal)	—	25.8 cm^2	0.98
Horizontal surfaces(1)	9.5 mm rib lath	—	—	1.84
	Cedar lath	—	—	—

(1) See Appendix A, NBC

(8) Fasteners on horizontal surfaces shall be spaced not more than 150 mm o.c. along the framing members when members are spaced not nore than 400 mm o.c., and 100 mm o.c. along members when members are spaced not more than 600 mm o.c.

E. STUCCO MIXES

(1) Stucco mixes shall conform to Table 29C.

TABLE 29C: STUCCO MIXES BY VOLUME

Portland Cement	Masonry Cement Type H	Lime	Aggregate
1 1	--- 1	1/4 to 1 ---	3 1/4 to 4 parts per part of cementitious material

(2) Pigment if used shall consist of pure mineral oxides inert to the action of sun, lime or cement. Pigment shall not exceed 6 per cent of the portland cement by weight.

(3) Materials shall be thoroughly mixed before and after water is added. Stucco shall be applied not later than 3 h after the initial mixing.

F. STUCCO APPLICATION

(1) The base for stucco shall be maintained above freezing. Stucco shall be maintained at a temperature of not less than 10°C during applications, and for not less than 48 h afterwards.

(2) Stucco shall be applied with not less than 2 base coats and 1 finish coat providing a total thickness of at least 15 mm measured from the face of the lath or face of the masonry where no lath is used.

(3) The first coat shall be not less than 6 mm thick measured from the face of the lath or masonry, fully embedding the lath. The surface shall be scored to provide a key with the second coat.

(4) The second coat shall be not less than 6 mm thick. The surface shall be lightly roughened to provide a key with the finish coat if the finish coat is other than stone dash.

(5) When the finish coat is other than stone dash, the base shall be dampened but not saturated before the finish coat is applied. The thickness of the finish coat shall be not less than 3 mm.

(6) When a stone dash finish is used, the stone shall be partially embedded in the second coat before the second coat starts to set or stiffen.

SECTION 30. INTERIOR WALL AND CEILING FINISHES

A. GENERAL

(1) This Section applies to all buildings, regardless of size.

(2) The requirements for plastering in this Section apply to the application of plaster to gypsum or metal lath attached to wood furring or framing. Plaster applications and plaster mixes not described in this Section and requirements for metal framing and metal furring shall conform to CSA A82.30, "Interior Furring, Lathing and Gypsum Plastering." Flame spread requirements are contained in Subsection 10 P.

(3) The requirements for wall and ceiling finishes in this Section are basic requirements. Where a wall or ceiling assembly is required to provide a certain fire-resistance rating, a flame-spread rating or a sound transmission class rating, the wall or ceiling finish shall be subject to the appropriate requirements in Section 10 and 11 in addition to the requirements in this Section.

B. WATERPROOF WALL FINISH

(1) Waterproof finish shall be provided to a height of not less than 1.3 m above the floor in shower stalls, 1.2 m above the rims of bathtubs equipped with showers, and 400 mm above the rims of bathtubs not equipped with showers.

(2) Waterproof finish shall consist of ceramic, plastic or metal tile,tempered hardboard, laminated thermosetting decorative sheets or linoleum.

C. WOOD FURRING

(1) Wood furring for the attachment of wall and ceiling finishes shall conform to Table 30A.

(2) Furring shall be fastened to the framing or to wood blocks with not less than 51 mm nails.

TABLE 30A: MINIMUM SIZE OF FURRING,mm

Maximum Spacing of furring, mm	Maximum Spacing of Furring Supports		
	Continuous Support	400 mm o.c.	600 mm o.c.
300	19 by 38	19 by 38	19 by 64
400	19 by 38	19 by 38	19 by 64
600	19 by 38	19 by 64	19 by 89

D. GYPSUM LATH

(1) Gypsum lath shall conform to CSA A82.27, "Gypsum Board Products."

(2) Gypsum lath shall be not less then 9.5 mm thick on supports not more than 400 mm o.c., and 12.7 mm thick on supports not more than 600 mm o.c.

(3) Gypsum lath shall be applied so that vertical joints do not occur at jamb studs above or below openings.

(4) Gypsum lath shall be fastened at each support with not fewer than 4 uniformly spaced fasteners where 406 mm wide lath is used on vertical supports spaced not more than 400 mm o.c. Such lath shall be fastened with not fewer than 5 fasteners per support for all other conditions. Lath 610 mm wide shall be fastened with no fewer than 6 fasteners per support. Lath need not be nailed to the framing at inside corners.

(5) Nails for fastening gypsum lath shall be blued steel wire nails not less than 32 mm long, with at least 2.29 mm shank diameter and 7.5 mm head diameter.

(6) Staples for fastening gypsum lath shall be not less than 25 mm long for 9.5 mm thick lath and 28 mm long for 12.7 mm lath. Staples shall be not less than 1.6 mm diam or thickness with not less than a 19 mm crown.

E. METAL LATH

(1) Metal lath shall consist of galvanized metal or copper-bearing steel treated with a suitable rust-inhibitive coating after manufacture.

(2) The weight of metal lath shall conform to Table 30B.

(3) Paper backed welded wire lath shall consist of wire not less than 1.6 mm in diameter except that when applied to supports spaced more than 400 mm o.c., every third wire at right angles to the supports shall be not less than 2.9 mm in diameter.

(4) Nails for the attachment of metal lath shall be not less than 3.2 mm diameter large-head roofing nails not less than 38 mm long for ceiling supports and 25 mm long for wall supports. Such nails shall be spaced not more than 150 mm o.c.

(5) Staples for the attachment of metal lath shall be not less than 2 mm diameter or thickness nor less than 38 mm long with a 19 mm crown. Such staples shall be spaced not more than 150 mm o.c.

(6) Metal lath shall be applied at right angles to the supports. End joints shall be lapped not less than 25 mm. Side joints of diamond mesh lath shall be lapped not less than 12 mm. Side joints of rib lath shall be lapped so that the adjacent side ribs nest. End joints shall be staggered. End laps that occur between supports shall be tied.

TABLE 30B: MINIMUM MASS OF METAL LATH

Type of Lath	Minimum Mass, kg/m^2	Max. Spacing of Wood Supports, mm	
		Walls	Ceilings
Diamond mesh	1.36 1.63	300 400	300 300
Flat rib	1.36 1.63	400 400	300 400
9.5 mm rib	1.36 1.63 1.90	400 500 600	400 500 600
Paper-backed welded wire	0.76 1.06	400 600	400 600

(7) When metal lath is applied over a continuous surface, it shall be held not less than 6 mm from the back-up by means of furring strips, self-furring nails or self-furring lath.

F. CORNER REINFORCEMENT FOR PLASTER

(1) Material for corner reinforcement shall have at least the same corrosion resistance as metal plaster lath.

(2) All internal corners of walls and ceilings shall be reinforced with metal lath or wire fabric having not less than 50 mm wide legs. Corner beads shall be installed at all external corners.

(3) Corners of openings shall be reinforced with a strip of metal lath not less than 150 mm by 450 mm long installed at an angle of 45° to the horizontal.

(4) All plaster reinforcement shall be fastened to the lath and not to the framing.

G. PLASTERING

(1) Materials used in plastering shall conform to the following:

NBC

CSA A82.21, "Gypsum and Terms Relating to Gypsum Products"
CSA A82.22, "Gypsum Plasters", or
CSA A82.57, "Inorganic Aggregates for Use in Interior Plaster"

(2) Grounds shall be installed to ensure even and uniform plaster thickness.

(3) Plaster shall be not less than 10 mm thick at any point, measured from the face of the lath. Where electric cables for heating are embedded in the plaster, there shall be not less than 10 mm of plaster covering the cables.

(4) Plaster shall be applied in three coats consisting of a scratch coat, brown coat and finish coat, except that where the base consists of gypsum lath or unit masonry other than concrete masonry, a 2-coat application may be used in which a brown coat is doubled back over the scratch coat.

(5) When plaster is applied over concrete or concrete masonry, a special bond coat shall be used as the first coat, or a liquid bonding agent conforming to CSA A261, "Liquid Bonding Agents for Interior Plasters" shall be applied before the application of the first coat of plaster. Normal finishing hydrated lime shall not be used in plaster applied to exterior masonry or concrete walls.

(6) Plaster to embed cables used for electric heating shall not incorporate lightweight aggregate.

(7) When 3-coat plaster is used, the first or scratch coat shall consist of 1 part gypsum plaster to 2 parts sand by weight. The second or brown coat shall consist of 1 part gypsum plaster to 3 parts sand by weight. The finish coat shall consist of 1 part gypsum plaster to 3 parts lime by volume.

(8) When 2-coat plaster is used, the first coat shall consist of 1 part gypsum plaster to 2-1/2 parts sand by weight. The finish coat shall consist of 1 part gypsum plaster to 3 parts lime by volume.

(9) The finish coat shall be trowelled to a smooth hard finish unless a special decorative finish is used conforming to CSA A82.22 "Gypsum Plasters."

(10) In cold weather, plaster shall be applied at from 10°C to 320°C and maintained at this temperature range for not less than 96 h and above freezing thereafter. Ventilation shall be provided for the proper drying of the plaster.

H. GYPSUM BOARD FINISH (TAPED JOINTS)

(1) Gypsum board shall conform to CSA A82.27, "Gypsum Wallboard."

(2) Gypsum board applied as a single layer shall be not less than 9.5 mm thick on supports not more than 400 mm o.c. and 12.7 mm thick on supports not more than 600 mm o.c. When applied as 2 layers, each layer shall be not less than 9.5 mm thick on supports not more than 600 mm o.c.

(3) The length of fasteners for gypsum board shall conform to Table 30C, except that lesser depths of penetration are permitted for assemblies required to have a fire-resistance rating provided it can be shown, on the basis of fire tests, that such depths are adequate for the required rating.

TABLE 30C: FASTENER PENETRATION INTO WOOD SUPPORTS

Required Fire-Resistance of Assembly, h	Minimum Fastener Penetration Into Wood Supports, mm			
	Walls		Ceilings	
	Nails	Screws	Nails	Screws
Fire-resistance not required	20	15	20	15
3/4	20	20	30	30
1	20	20	45	45
1 1/2	20	20	60	60

(4) Nails for fastening gypsum board to wood supports shall be not less than 2.3 mm shank diameter annular grooved nails with a head diameter of 5.5 mm.

(5) For single layer application, nails shall be spaced not more than 180 mm o.c. on ceiling supports and not more than 200 mm apart along vertical wall supports, except that nails may be spaced in pairs about 50 mm apart every 300 mm along such walls or ceiling supports. Where the ceiling sheets are supported by the wall sheets around the perimeter of the ceiling, this support may be considered as equivalent to nailing at this location. The uppermost wall nails shall be not more than 200 mm below the ceiling. Nails shall be located not less than 10 mm from the side or edge of the board. Nails shall be driven so that the heads are below the plane of the board surface but do not puncture the paper.

(6) NBC For double-layer applications the first layer shall be fastened as in (5). The joints in the second layer shall be offset from the joints in the first layer, and the second layer shall be fastened so that the nails penetrate into wood supports the same depth as is required for the first layer.

(7) Where strip laminated method of application is used, strips of gypsum board not less than 9.5 mm thick and 150 mm wide shall be nailed to the framing members with nailing conforming to (5). The finish layer of gypsum board shall be attached by means of a suitable adhesive to these strips as described in (6).

(8) Where gypsum board is applied with drywall screws, the screws shall be spaced not more than 300 mm o.c.along supports, except that on vertical surfaces the screws may be spaced 400 mm o.c. where supports are not more than 400 mm o.c.

(9) In cold weather the taping and finishing of gypsum board shall be carried out at a temperature of not less than 10°C.

(10) Nail heads and screw heads shall be covered with a suitable filler.

(11) Surfaces to receive tape shall be clean, and torn paper or loose material shall be removed. Openings greater than 3 mm shall be filled with patching plaster that is allowed to dry before joint tape cement is applied.

(12) External corners shall be protected with corrosion-resistant metal corner beads or wood mouldings.

(13) A band of joint cement about 120 mm wide shall be applied along the joints to embed the tape. The tape shall be smoothed out and excess cement removed with a suitable spreader tool.

(14) After the cement has dried, a second layer of cement shall be applied so that it completely covers the tape. The edges of the cement shall be feathered to provide a band about 200 mm wide where the joints are recessed and 250 mm wide where the joints are not recessed.

(15) After the second layer is dry, a third layer of cement shall be applied and feathered to provide a band about 250 mm wide where the joints are recessed and 400 mm wide where the joints are not recessed.

(16) After the third layer of cement has dried, all rough and uneven areas shall be sanded to provide a smooth even surface.

I. PLYWOOD FINISH

(1) The minimum thickness of plywood interior finish shall conform to Table 30D, except that no minimum thickness is required when the plywood is applied over solid backing. Thicknesses listed in Table 30D shall permit a manufacturing tolerance of +/-0.4 mm.

(2) Where plywood for interior finish is grooved, the grooves shall not extend through the face ply and into the piles below the face ply unless the groove is supported by framing or furring, or if the grain of the face ply is at right angles to the supporting members, unless the thickness of the plywood exceeds the value shown in Table 30D by an amount equal to at least the depth of penetration of the grooves into the piles below the face ply.

(3) Nails for attaching plywood finishes shall be not less than 38 mm casing or finishing nails spaced not more than 150 mm o.c. along edge supports and 300 mm o.c. along intermediate supports, except that staples providing equivalent lateral resistance may also be used.

(4) All plywood edges shall be supported by furring, blocking or framing.

TABLE 30D: MINIMUM THICKNESS OF PLYWOOD INTERIOR FINISH

Maximum Spacing of Supports, mm o.c.	On Supports with no Horizontal Backing, mm	On Supports with Blocking at Vertical Intervals not Exceeding 1.2 m, mm
400	4.7	4.0
600	8.0	4.7

J. HARDBOARD FINISH

(1) Hardboard shall conform to CGSB 11-GP-3M,"Hardboard."

(2) Hardboard shall be not less than 3.2 mm thick where applied over continuous back-up, 6 mm thick where applied to supports spaced not more than 400 mm o.c. and 9 mm thick where applied to supports spaced not more than 600 mm o.c.

(3) Nails for fastening hardboard shall be casing or finishing nails not less than 38 mm long, spaced not more than 150 mm o.c. along edge supports and 300 mm o.c. along intermediate supports.

(4) All hardboard edges shall be supported by furring, blocking or framing where the back-up is not continuous.

K. INSULATING FIBREBOARD FINISH

(1) Insulating fibreboard shall conform to CSA A247, "Insulating Fibreboard."

(2) Insulating fibreboard sheets shall be not less than 11.1 mm thick on supports not more than 400 mm o.c. Insulating fibreboard tile shall be not less than 12.7 mm thick on supports spaced not more than 400 mm o.c.

(3) Nails for fastening fibreboard sheets shall be not less then 2.6 mm shank diameter casing or finishing nails of sufficient length to penetrate at least 20 mm into the supports. Nails shall be spaced not more than 100 mm o.c. along edge supports and 200 mm o.c. along intermediate supports.

(4) All fibreboard edges shall be supported by blocking, furring or framing.

L. PARTICLEBOARD OR WAFERBOARD FINISH

(1) Particleboard finish shall conform to CAN3-0188.1, "Interior Mat-Formed Wood Particleboard". Waferboard finish shall conform to CAN3-0188.2, "Waferboard."

(2) Particleboard or waferboard shall be not less than 6.35 mm thick on supports not more than 400 mm o.c. and not less than 9.5 mm thick on supports not more than 600 mm o.c., except that in walls where blocking is provided at mid-wall height, particleboard or waferboard shall have a thickness of not less than 6.35 mm on supports not more than 600 mm o.c.

(3) Nails for fastening particleboard or waferboard shall be not less than 38 mm casing or finishing nails spaced not more than 150 mm o.c. along edge supports and 300 mm o.c. along intermediate supports.

(4) All particleboard or waferboard edges shall be supported by furring, blocking or framing.

M. WALL TILE FINISH

(1) Ceramic tile shall be set in a mortar base or applied with an adhesive. Plastic tile shall be applied with an adhesive.

(2) When ceramic tile is applied to a mortar base the cementitious material shall consist of 1 part portland cement to not more than 1/4 part lime by volume. This shall be mixed with not less than 3 nor more than 5 parts of aggregate per part of cementitious material by volume. Mortar shall be applied over metal lath or masonry. Ceramic tile applied to a mortar base shall be thoroughly soaked and pressed into place forcing the mortar into the joints while the tile is wet.

(3) Adhesive to attach ceramic or plastic tile shall be applied to the finish coat or brown coat of plaster that has been steel-trowelled to an even surface or to gypsum board or to masonry provided the masonry has an even surface.

(4) NBC Ceramic or plastic tile installed on walls around bathtubs or showers shall be applied over moisture resistant backing.

(5) NBC The joints between wall tiles and a bathtub shall be suitably caulked with materials conforming to CGSB 19-GP-22 "Standard for: Sealing Compound, Mildew Resistant, for Tubs and Tile."

N. INTERIOR TRIM

(1) Interior trim shall be provided where necessary to cover unprotected edges of friable wall finishes or where the junction of 2 surfaces is not finished to provide an acceptable appearance.

(2) Trim shall be made of wood, metal, plastic or other acceptable material.

(3) Steel trim shall be primed with a rust-inhibitive paint before installation or otherwise treated to prevent corrosion.

(4) Aluminum mouldings shall be treated with a protective coating when in contact with masonry, plaster, mortar or concrete.

(5) Wood trim shall be smooth, clean, sound stock suitable for finishing. Moisture content at the time of installation shall not exceed 12 per cent.

SECTION 31. FLOORING

A. GENERAL

(1) This Section applies to all buildings, regardless of size.

(2) Finished flooring shall be provided in all residential occupancies.

(3) Finished flooring in bathrooms, kitchens, public entrance halls, laundry and general storage areas shall consist of resilient flooring, felt-synthetic-fibre floor coverings, concrete, terrazzo, ceramic tile, mastic or other types of flooring providing similar degrees of water resistance.

(4) NBC Wood sleepers supporting finished flooring over a concrete base supported on the ground shall be not less than 19 mm by 38 mm and shall be treated with a wood preservative.

(5) Finished flooring shall have a surface that is smooth, even and free from roughness or open defects.

B. PANEL-TYPE UNDERLAY

(1) A panel-type underlay shall be provided under resilient flooring, parquet flooring, ceramic tile, felted synthetic-fibre floor coverings or carpet laid over lumber subflooring.[See C(3)].

(2) A panel-type underlay shall be provided under resilient flooring, parquet flooring, felted synthetic-fibre floor coverings, carpeting or ceramic tile on panel-type subflooring whose edges are unsupported.[See 23 N(4)].

(3) Panel-type underlay shall be not less than 6 mm thick and shall conform to one of the following:

CSA 0115, "Hardwood and Decorative Plywood."
CSA 0121, "Douglas Fir Plywood."
CSA 0151, "Canadian Softwood Plywood."
CSA 0153, "Poplar Plywood."
CAN3-0188,"Interior Mat-Formed Wood Particleboard."
CAN3-0188,"Waferboard." or
CGSB 11 GP, "Hardboard."

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(4) Panel-type underlay shall be fastened to the subfloor with staples or spiral nails or annular grooved flooring nails, spaced not more than 150 mm o.c. along the edges and 200 mm o.c. both ways at other locations.

(5) Nails for panel-type underlay shall be not less than 19 mm long for 6 mm thick underlay and 22 mm long for 7.9 mm thick underlay. Staples for panel-type underlay shall have not less than a 1.2 mm shank diameter or thickness with a 4.7 mm crown and shall be not less than 22 mm long for 6 mm underlay and 28 mm long for 7.9 mm and 9.5 mm underlay.

(6) Where panel-type underlay is required to be installed over plywood or waferboard, the joints in the underlay shall be offset at least 200 mm from the joints in the underlying subfloor.

(7) Underlay beneath resilient or ceramic floors applied with an adhesive shall have all holes or open defects on the surface patched so that the defects will not be transmitted to the finished surface.

C. WOOD STRIP FLOORING

(1) The thickness of wood strip flooring shall conform to Table 31A.

(2) Wood strip flooring shall not be laid parallel to lumber subflooring unless a separate underlay is provided.

(3) If wood strip flooring is applied without a subfloor, it shall be laid at right angles to the joists so that the end joints are staggered and occur over supports or are end matched. If the flooring is end matched, it shall be laid so that no two adjoining strips break joints in the same space between supports and each strip bears on no fewer than two supports.

(4) When nails are used wood strip flooring shall be toe nailed or face nailed with at least 1 nail per strip at the spacings shown in Table 31B, except that face nailed strips of more than 25 mm in width shall have no fewer than 2 nails per strip. Face nails shall be countersunk and the holes filled with suitable filler.

(5) Staples may be used to fasten wood strip flooring not more than 7.9 mm in thickness provided the staples are not less than 29 mm long with a shank diameter of 1.19 mm and with 4.7 mm crowns.

TABLE 31A - WOOD STRIP FLOORING

Type of Flooring	Maximum Joist Spacing, mm	Minimum Thickness of Flooring, mm	
		With Subfloor	No Subfloor
Matched hardwood (interior use only)	400 600	7.9 7.9	19.0 33.3
Matched softwood (interior or exterior)	400 600	19.0 19.0	19.0 31.7
Square edge softwood (exterior use only)	400 600	— —	25.4 38.1

TABLE 31B—NAILING OF WOOD STRIP FLOORING

Finish Floor Thickness, mm	Minimum Length of Flooring Nails, mm	Maximum Spacing of Flooring Nails, mm
7.9	38(1)	200
11.1	51	300
19.0	57	400
25.4	63	400
31.7	70	600
38.1	83	600

Note: (1) See 31C(5)

D. PARQUET FLOORING

Adhesive used to attach parquet block flooring shall be suitable for bonding wood to the applicable subfloor material.

E. RESILIENT FLOORING

(1) Resilient flooring used on concrete slabs supported on ground shall consist of asphalt, rubber, vinyl-asbestos, unbacked vinyl with an inorganic type backing. Such flooring shall be attached to the base with a suitable waterproof and alkali-resistant adhesive.

(2) Resilient flooring shall conform to one of the following:
CSA A100, "Asphalt Floor Tile."
CSA A146, "Linoleum Products."
CSA A126, "Vinyl Asbestos Floor Tile."
CSA A145, "Rubber Floor Tile," or
CSA A126, "Sheet Vinyl Flooring Products."

F. CERAMIC TILE

(1) Ceramic tile shall be set in a mortar bed or applied to a sound, smooth base with a suitable adhesive.

(2) When set in a mortar bed the bed shall be not less than 30 mm thick. Asphalt sheathing paper, felt or polyethylene film shall be applied under the mortar bed when the mortar is applied over wood subfloors. The mortar shall consist of 1 part portland cement to not more than 1/4 part lime to not less than 3 nor more than 5 parts of aggregate per part of cementitious material by volume. The tile shall be soaked before installation and pressed firmly into place while the mortar is still plastic. The mortar shall be compressed into the tile joints and the joints tooled the same day the tile is installed. Where no spacers are provided the joints shall not exceed 2 mm in width.

(3) Ceramic tile installed with an adhesive shall be applied over a smooth base of concrete or over a panel-type underlay as described in Subsection B, except that particleboard shall meet the exterior bond and test requirements for Grade N-1 or N-2 board in CAN3-0188, "Interior Mat-Formed Wood Particleboard." The adhesive shall be applied to both the base and the tile.

G. CARPETING

(1) Carpeting shall not be used as a finish flooring in kitchens, bathrooms, washrooms, laundry areas or other areas where excessive amounts of water are likely to be encountered unless accepted.

(2) When carpeting is used it shall be laid over concrete or panel-type subflooring or over lumber subflooring covered with a panel-type underlay conforming to Subsection B.

(3) Carpeting shall conform to the following specification: CGSB 4-GP-161, "Carpets for Residential Use."

(4) A carpet underlay shall be provided beneath the carpeting. This shall consist of a felt type weighing not less than 1.08 kg/m2 conforming to CGSB 4-GP-36, to CGSB 20-GP-23, "Cushion ,Carpet: Flexible Polymeric Material", at least 4.8 mm thick for Type 1 and 6.35 mm thick for Type 11 or 111.

H. FELTED-SYNTHETIC-FIBRE FLOOR COVERINGS

(1) Felted-synthetic-fibre floor coverings may be used in all rooms and spaces. When a felted-synthetic-fibre floor covering is used, it shall be laid over concrete or panel-type subflooring or over lumber subflooring covered with a panel-type underlay conforming to Subsection B.

(2) A carpet underlay shall not be used beneath felted-synthetic-fibre floor coverings in those areas where carpeting is not permitted (see G(1)).

SECTION 32. PLUMBING FACILITIES

A. SCOPE

(1) The requirements in this Section apply to all buildings, regardless of size.

(2) This Section applies to plumbing facilities and plumbing systems within dwelling units.

(3) Facilities in plumbing systems other than those required in this Section shall conform to Part 3 of the NBC.

B. GENERAL

(1) The construction, extension, alteration, renewal or repair of plumbing systems and sewage disposal systems shall conform to Part 7 of the NBC except as required in this Section.

(2) Fixture clearances shall conform to the requirements of Section 5.

(3) Washrooms and water-closet rooms intended for common use in buildings required by Subsection 9B to be accessible to persons in wheelchairs shall conform to the appropriate requirements for public washrooms and toilet rooms in Section 3.7 of the NBC.

(4) Where a domestic hot water system is used for space heating, the design shall take into account the need for the capacity and recovery rate of the system (See also Section 34).

C. WATER SUPPLY AND DISTRIBUTION

(1) Every dwelling unit shall be supplied with potable water.

(2) Water supply by individual well or by trucked delivery shall be considered to be equivalent to a piped water supply.

(3) Where electricity is available, water shall be distributed to all fixtures at a pressure of not less than 100 kPa.

(4) Where a piped water supply is available, piping for hot and cold water shall be connected to every kitchen sink, lavatory, bathtub, shower, slop sink and laundry area. Piping for cold water shall be run to every water closet and hose bib.

(5) Where individual wells deliver less than 20 L/min per dwelling unit over a 1 h period, not less than 900 L cold water storage shall be provided per dwelling unit.

(6) Where water is delivered by truck, the cold water storage tank shall have a capacity of not less than 1100 L per dwelling unit.

(7) Except for a pressure or hot water tank, a water storage tank shall be designed, constructed and installed to ensure that:

(a) the tank is capable of withstanding the internal pressures produced by the supply truck pump,

(b) the tank is capable of resisting corrosion which may be caused by the properties of the local water,

(c) the tank does not permit the water to come into contact with materials that will introduce objectionable chemicals or produce an objectionable taste,

(d) it is possible to inspect and clean the interior of the tank,

(e) the tank is removable for repair or replacement, and

(f) the contents are protected against freezing.

(8) Where a fill pipe is provided for a cold water storage tank, an overflow pipe shall also be provided. Both pipes shall be at least 50 mm in diameter, and shall be so constructed as to prevent water from remaining within them from a point at least 300 mm inside the building envelope to their outer extremities.

D. REQUIRED FACILITIES

(1) A kitchen sink, lavatory, bathtub and water closet shall be provided for every dwelling unit where a piped water supply is available.

(2) Laundry facilities or a space for laundry facilities shall be provided in every dwelling unit or grouped elsewhere in the building in a location conveniently accessible to occupants of every dwelling unit.

(3) Where a piped water supply is available a hot water supply shall be provided in every dwelling unit.

(4) Where gravity drainage to a sewer, drainage ditch or dry well is possible, a floor drain shall be installed in a basement or cellar forming part of a dwelling unit.

(5) Where a floor drain can be connected to a sewerage system, a floor drain shall be provided in a garbage room, an incinerator room, a service room serving more than 1 dwelling unit, or any service room containing a water tank.

(6) Every public water-closet room shall be equipped with at least 1 water closet and 1 lavatory (see Subsection 5J).

(7) Every janitor's water-closet room shall be equipped with 1 water closet and 1 lavatory or slop sink (see Subsection 5J).

(8) Where a piped water supply is available, except for tank storage systems, at least 1 outside hose bib with inside shut-off valve and drain cock or other acceptable draining device shall be provided for each building and for each ground-floor dwelling unit in a building in which there is no dwelling unit above another dwelling unit. In row-housing, bibs are to be provided alternately at front and back.

(9) Bathrooms in dwelling units shall be equipped with a wall cabinet or vanity, a mirror, toilet paper holder, soap dish, grab bar and towel bar. When a shower is provided, a shower rod or enclosure shall be installed.

(10) Where automatic washing machines are provided, there shall be at least 1 machine for every 20 dwelling units.

(11) Where automatic clothes dryers are provided there shall be at least 1 domestic size dryer for every 20 dwelling units, or commercial dryers providing equivalent capacity shall be provided.

E. SEWAGE DISPOSAL

(1) ABC Wastes from every plumbing fixture shall be piped to the building sewer.

(2) Building sewers shall discharge into a public sewage system where such a system is available.

(3) Where a piped water supply is provided, every laundry room or space shall have a waste connection for the disposal of laundry water.

(4) Where a public sewage system is not available, the building sewer shall discharge into a private sewage disposal system, or holding tank.

(5) Where water and sewage holding tanks are provided, the capacity of the sewage holding tank shall be not less than 1.25 times that of the cold water storage tank.

(6) A sewage holding tank shall be designed, constructed and installed to ensure that:

(a) the tank is removable for repairs or replacement,
(b) the contents of the tank are protected against freezing,
(c) provision is made for the possibility of differential movement between the building and the sewage tank,
(d) the tank is capable of withstanding the pressures produced within the tank when the contents are pumped out,
(e) liquid will not be drawn from traps in the dwelling plumbing system during pump-out operations.
(f) it is possible to empty the tank from the the exterior of the building,
(g) the pump-out connection shall be designed so that it is compatible with local pump-out equipment and so that any residual material left within the pipe upon completion of the pump-out operation will drain back into the tank, and
(h) the design of pump-out connection system eliminates the possibility of creating a vortex in the liquid being pumped out.

F. SERVICE WATER HEATING FACILITIES (see also Section 34)

(1) Where a hot water supply is required by D(3), equipment shall be installed to provide to every dwelling unit an adequate supply of service hot water with a temperature range from 60°C to 75°C.

(2) Service hot water may be distributed from a centrally located heater to supply the entire building or may be supplied by an individual service water heater for each dwelling unit.

(3) Every service water heater and its installation shall conform to Part 6 of the NBC.

(4) Where storage tanks for service water heaters are of steel, they shall be coated with zinc, vitreous enamel (glass lined), hydraulic cement or other corrosion-resistant material.

(5) Fuel-burning service water heaters shall be connected to a chimney flue conforming to Section 21.

(6) Heating coils of service water heaters shall not be installed in a flue or in a combustion chamber of a building heating boiler or furnace.

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(7) Tanks for service water heaters shall be glass lined in conformance with CSA C309, "Performance Requirements for Glass-lined Storage Tanks for Household Hot Water Service", or be lined with at least 9.5 mm of hydraulic cement covering the inside of the tank without voids, or be constructed of materials capable of providing a minimum service life of 10 years with the kind of water encountered.

(8) Central storage tanks for service water heaters serving more than 1 dwelling unit may consist of non-galvanized steel rated at not less than 860 kPa water pressure.

TABLE 32A - ELECTRIC SERVICE WATER HEATERS, STORAGE TYPE

No. of Bathrooms*	No. of Bedrooms	Min. Tank Capacity, L	Minimum Wattage of Elements		
			Single Element Type	Dual Element Type (nonsimultaneous operation)	
				Primary Element	Secondary Element
1	1 or 2	90	1 000	750	1 000
	3 or 4	135	1 500	1 000	1 000
2	2 or 3	180	2 000	1 000	1 000
	4 or 5	180	2 500	1 000	3 000

Note to Table 32A: * Rooms containing a shower or bathtub

(9) The minimum storage tank capacity and watt input for electric storage type service water heaters serving individual dwelling units shall conform to Table 32A. Other combinations of tank capacity and element wattage may be used where it can be shown that such combinations will provide an equivalent supply of hot water.

TABLE 32B - NONELECTRIC SERVICE WATER HEATERS, STORAGE TYPE

No. of Bathrooms*	No. of Bedrooms	Min. Tank Capacity, L	Minimum Heating Capacity (L) raised 55°C in 1 h
1	1 or 2	60	55
	3 or 4	70	55
2	2 or 3	100	70
	4 or 5	135	95

Note to Table 32B: * Rooms containing a shower or bathtub

TABLE 32C - MINIMUM HEATING CAPACITY
(L/h at 55°C temperature rise)

Max. No. of Dwelling Units*	Min. Storage Capacity per Dwelling Unit**					
	0 Instantaneous	25	50	75	100	125
3	1 330	130	111	96	84	74
5	1 540	215	185	157	137	122
10	1 780	435	371	315	274	231
15	1 950	646	557	472	410	347
20	2 110	865	739	627	542	466
25	2 260	1 040	1 010	755	655	559
30	2 430	1 220	1 040	885	764	655
40	2 730	1 520	1 300	1 100	950	807
50	3 070	1 770	1 500	1 270	1 090	935
60	3 410	2 000	1 690	1 420	1 210	---
80	3 980	2 320	1 940	1 590	---	---
100	4 360	2 420	1 990	---	---	---
150	5 270	2 530	---	---	---	---
200	6 050	3 360	---	---	---	---
250	6 820	---	---	---	---	---
300	7 590	---	---	---	---	---

Notes to Table 32C:

* For numbers of dwelling units not listed, interpolations may be made to determine recovery capacity.

** For storage capacities not listed, interpolations may be made to determine recovery capacity.

(10) The minimum storage and heating capacity of nonelectric storage type service water heaters for individual dwelling units shall conform to Table 32B. Other combinations of tank capacity and recovery rates may be used where it can be shown that such combinations will provide an equivalent supply of hot water.

(11) The minimum heating capacity in litres per hour raised through 55°C for instantaneous or tankless heaters serving individual dwelling units shall be 650 for dwelling units with 1 bathroom and 1100 for dwelling units with 2 bathrooms.

(12) Service water heaters of any type serving more than 1 dwelling unit shall have a minimum heating capacity in litres per hour raised through 55°C conforming to Table 32C.

(13) Storage tanks for service water heaters shall be insulated with mineral wool, cellular asbestos or other acceptable material.

G. ADDITIONAL REQUIREMENTS

(1) Where a vent pipe passes through a roof and may be subject to closure by frost, it shall be protected from such frost closure by ensuring that:

a) there are no connections from the vent pipe to the stack vent outside the building envelope,

b) the vent pipe is of metal construction from a point at least 1 m within the heated portion of the building to its termination,

c) the vent pipe is insulated from the point where it passes through the building envelope to its termination, to at least half the value of the thermal performance required for that part of the building envelope, and

d) the vent pipe does not project more than 30 mm above the roof.

(2) Only self-closing faucets shall be used in areas where there may be public access.

(3) Urinals for public use shall not be of the self-flushing type.

(4) Provisions shall be made for pipes and tanks containing water to be drained to the outdoors in case of emergency.

SECTION 33. VENTILATION AND HEAT RECOVERY

A. SCOPE

(1) NBC This Section applies to the ventilation of rooms and spaces in residential occupancies by natural ventilation and to self-contained mechanical ventilation systems serving only 1 dwelling unit.

(2) Mechanical ventilation systems serving more than 1 dwelling unit shall conform to this Section and to Part 6 of the NBC.

(3) NBC A storage garage for more than 5 cars shall be ventilated in accordance with Part 6 of the NBC.

(4) Where the ventilation system forms part of the heating system, Section 34 shall also apply.

(5) For provision of air to combustion appliances, see Section 34.

B. GENERAL

(1) Ventilation adequate to maintain air quality at acceptable levels for occupants shall be provided to rooms or spaces within dwellings, either by means of a natural ventilation system, in conformance with Subsections C and E, or by a mechanical ventilation system in conformance with Subsections D and E.

(2) Appliances that are designed to discharge the products of combustion to the outdoors through a flue shall be supplied with air in accordance with Subsection 34C and shall be isolated from dwelling spaces in accordance with Subsection 34D.

(3) Where mechanical equipment is provided which exhausts or supplies air to a dwelling, but which does not satisfy the air change requirements of D(1), all of the requirements of Subsection C shall be met.

(4) Where air contaminants may be released within a building, the ventilation system shall be designed to remove them, insofar as possible, at their points of origin, and they shall not be permitted to accumulate in unsafe concentrations. This requirement shall include appliances such as gas refrigerators or portable kerosene heaters that are designed to operate without discharging the products of combustion to the outdoors through a flue.

(5) Every building in which dust, fumes, gases, vapour or other contaminants tend to create a fire or explosion hazard shall be provided with an exhaust ventilation system designed to conform with Part 6 of the NBC, and shall be provided with explosion relief devices and vents or other protective measures to conform with Part 3 of the NBC.

(6) No air from any dwelling unit shall be circulated directly or indirectly to any other dwelling unit, public corridor or public stairway.

(7) Where air is introduced into any room or space, provision shall be made for it to leave that room or space.

C. NATURAL VENTILATION SYSTEMS

(1) The unobstructed ventilation area to the outdoors for rooms and spaces in residential buildings ventilated by natural sources shall conform to Table 33A. Such ventilation shall not be through an unheated room or space.

(2) Where ventilation openings other than windows or ducts are used to provide any part of the unobstructed ventilation area required by (1), they shall have vent closures that have a thermal resistance of not less than RSI 2.0, seals located on the warm side, and hardware for holding them in any position from fully open to fully closed and for fastening them in the closed position.

TABLE 33A - NATURAL VENTILATION

Location		Minimum Unobstructed Area
Within dwelling units	Bathrooms or water-closet rooms and service rooms	0.09 m^2
	Unfinished basement space	0.2 percent of the floor area
	Dining rooms, living rooms, bedrooms, kitchens, combined rooms, dens, recreation rooms and all other finished rooms	0.28 m^2 per room or combination of rooms
Other than within dwelling units	Bathrooms or water-closet rooms	0.09 m^2 per water closet
	Sleeping areas	0.14 m^2 per occupant
	Laundry rooms, kitchens and recreation rooms	4 percent of the floor area
	Corridors, storage rooms and other similar public rooms or spaces	2 percent of the floor area
	Unfinished basement space not used on a shared basis	0.2 percent of the floor area

(3) Where operable windows or vents are used to provide any part of the unobstructed ventilation area required by (1) they shall be designed, constructed and installed so as to prevent the formation of frost or ice that would prevent their operation.

(4) Where the requirements in Table 33A are in conflict with the requirements of 9I(2), the greater requirement shall apply.

D. MECHANICAL VENTILATION SYSTEMS

(1) Where a mechanical ventilation system is provided, it shall be designed to be capable of operating continuously and of providing a maximum rate of air change of at least 1.0 ach, based upon the finished interior volume of the dwelling unit. The system shall be provided with a variable speed control and a switch to allow the system to be turned off.

(2) Inlet and exhaust openings shall be so located that they open into the outside air at places where pressures due to winds will be less than 20% of the static pressure of the ventilating fans in operation.

(3) Outside ventilation air shall be tempered to at least 15°C before it enters any habitable room.

(4) Where an outdoor air intake is connected directly into the return air duct of an air circulation system, it shall be fitted with a balancing damper.

(5) Exhaust from laundry driers shall be ducted directly to the outdoors by a duct conforming to E(1), unless other provisions are made for the control of humidity and pollutants.

(6) See Subsection 10I where an exhaust duct serves more than 1 fire compartment.

E. ADDITIONAL REQUIREMENTS FOR VENTILATION SYSTEMS

(1) Air intake and exhaust outlets shall be provided and shall be shielded from the entry of birds, vermin, insects, rain and snow, including wind-driven snow. Screening shall be of rust-proof material. On air intake ducts, insect screening shall be fitted on a separate frame located in a warm space and fitted so as to be easily removable from the inside.

(2) Exhaust outlets that could reverse and air intakes for natural or mechanical ventilation shall be located so as to avoid contamination from combustion equipment, fuel storage tank vents, exhaust outlets, or exhaust from parked vehicles, or from other sources in concentrations greater than normal in the locality in which the building is located.

(3) Cold outside air shall not be introduced into a building or dwelling in such a way as to cause discomfort or to endanger pipes or equipment that might be damaged by freezing.

(4) Where outdoor air is introduced into the return air duct of a hot air furnace, a mixing device or other acceptable means shall be used to ensure that the cold air is tempered with the return air before reaching the heating equipment.

(5) Intake air ducts shall be insulated to prevent condensation from the point where they pass through the building envelope, to the point where the supply air is introduced into the living space or is tempered, as required in D(3). Joints in the ducts shall be sealed, and the insulation shall be encased in an air-tight and vapour retardant membrane. Where subject to mechanical damage and at all locations less than 1.5 m from the floor, the membrane shall be protected by a protective covering.

(6) Intake ducts for ventilation systems shall not pass through a combustion equipment room unless they are airtight and continuous.

(7) Exhaust ducts shall discharge directly to the outside and shall be insulated from the point where they pass through the building envelope to their extremities so as to maintain an inside surface temperature of not less than 10°C under the 1% January design temperature and with an inside house air temperature of 22°C. The ducts shall be sealed against leakage of air into the insulation.

(8) Ventilation equipment shall be accessible for inspection, maintenance, repair and cleaning.

(9) Where a kitchen exhaust duct is not equipped with a removable and washable grease filter at the intake end, the ventilation system to which it is connected shall be designed and installed so that it can be cleaned.

(10) Every ventilating duct shall conform to the requirements of Section 34.

(11) Underground ventilating ducts shall be adequately drained. Such ducts shall have no connections to public or private sewerage systems and shall be provided with access for inspection and cleaning.

G. HEAT RECOVERY SYSTEMS

(1) Where a system is installed to recover waste heat from the exhaust air, it must be so designed as not to unbalance the ventilation system or, by its failure, to impair the performance of the ventilation system, as required in Subsection D.

(2) All air streams entering heat recovery devices shall be filtered by means of cleanable or disposable filters.

(3) The core of a heat recovery device shall be accessible for cleaning or replacement.

(4) The system shall be designed to thaw any frost-blockage of the exhaust passages as quickly as possible and to restart the heat-exchange operation as soon as the exhaust passages are defrosted.

(5) Provisions shall be made to drain off all condensed water to a drainage system.

(6) Heat recovery devices shall be installed according to the provisions of Section 34.

SECTION 34. HEATING AND AIR-CONDITIONING

A. SCOPE

(1) This Section applies to the design and installation of heating systems, appliances and equipment (such as furnaces, boilers, service hot-water heaters, solid fuel stoves and cooking equipment) in which the heat input to the system or appliance or equipment does not exceed 120 kW and to air-conditioning systems in which the rated fan capacity does not exceed 2 m^3/s.

(2) Where the heat input of a heating system exceeds 120 kW or the rated fan capacity of an air-conditioning system exceeds 2 m^3/s, Part 6 of the NBC shall apply.

(3) Masonry fireplaces shall conform to Section 22.

B. GENERAL

(1) Residential buildings intended for use in the winter months on a continuing basis shall be equipped with heating facilities capable of maintaining an indoor air temperature of 22°C at the outdoor winter design temperature, except as provided in (2). Winter design temperatures shall be determined in conformance with Article 2.3.1.1. of the NBC.

(2) NBC Heating facilities shall be provided which shall be capable of maintaining a temperature not less than 18°C in an unfinished basement. Where crawl spaces are required to be heated, the heating facilities shall be capable of maintaining a temperature of not less than 15°C.

(3) NBC The design, including heat loss and heat gain calculations, for the construction and installation of heating and air conditioning systems shall conform to good engineering practice such as the procedures described in the ASHRAE Guide and Data Books, the ASHRAE Handbooks, the HRAI Digest, the Hydronics Institute Manuals and the SMACNA Manuals.

(4) Appliances and electric equipment shall be installed to conform to the following:

CSA B51, "Code for the Construction and Inspection of Boilers and Pressure Vessels,"

CSA B52, "Mechanical Refrigeration Code,"

CSA B139, "Installation Code for Oil Burning Equipment,"

CAN1-B149.1, "Installation Code for Natural Gas Burning Appliances and Equipment,"

CAN1-B149.2, "Installation Code for Propane Burning Appliances and Equipment," and

CSA C22.1, "Canadian Electrical Code, Part 1."

NBC CSA B365, "Installation Code for Solid-Fuel Burning Appliances and Equipment".

(5) Where an oil-fired combustion appliance is provided with a mechanical chimney flue damper, the damper shall conform to CSA 140-14, "Automatic Flue Dampers for use with Oil Fired Appliances".

(6) Where a supplementary or alternate heating system is installed, it shall conform in every respect to the requirements of this Section.

(7) Equipment forming part of a heating or air-conditioning system, except for concealed or embedded pipes or ducts, shall have easy access for inspection, maintenance and cleaning.

(8) NBC Heating systems or appliances using solid fuel shall not be connected to heating systems incorporating an oil-burning or gas-burning appliance or to an electrical heating device unless it can be shown that the total system is designed so that unsafe temperatures or water pressures will not occur with the operation of all or part of the combined system.

C. SUPPLY OF AIR TO COMBUSTION APPLIANCES

(1) Except as provided in (2), a combustion appliance that is designed to discharge the products of combustion to the outdoors through a flue shall be supplied with air for the purposes of combustion and dilution from the outdoors to the appliance, in a manner that prevents the interaction of the combustion and dilution air with the air in the room or space.

(2) Where combustion appliances or equipment are located in a combustion equipment room or enclosure, they shall be supplied with air from the outdoors in sufficient quantity for purposes of combustion and dilution. The supply of air shall not result in ambient temperatures within the service room or enclosure of less than 10°C. [see also B(4)].

(3) Air supplied to combustion appliances using liquid or gaseous fuels shall be at a temperature of not less than 10°C, unless the manufacturer's instructions permit lower temperatures for combustion air.

(4) Dilution air shall be at a temperature of not less than 10°C before it comes in contact with products of combustion.

(5) All ducts and openings supplying air to combustion appliances shall meet the requirements of B(4) and shall conform to the requirements of Subsection 33E.

D. ISOLATION OF COMBUSTION PRODUCTS FROM LIVING SPACES

(1) Where appliances are installed that are designed to discharge the products of combustion to the outdoors through a flue, the products of combustion shall be prevented from being drawn into habitable rooms or spaces under the action of other appliances or ventilation systems, either by the design of the appliance (including air intakes, flues, enclosures, and access panels or doors), or by the appliance being installed in a combustion equipment room which conforms to C(2) and Subsection 5M.

(2) For the requirements for fire separations between combustion appliances and habitable spaces, see Subsection 10 I.

E. DUCTS FOR LOW-CAPACITY AIR HEATING SYSTEMS

NBC

The design, construction and installation of air duct distribution systems serving heating systems in which the rated heat input does not exceed 120 kW shall conform to Subsections F,G,H and I, and to Subsection 6.2.3 of the NBC.

F. AIR SUPPLY DUCTS

(1) Galvanized steel or aluminum supply ducts shall conform to Table 34A. Other materials shall be noncombustible and shall have equivalent strength and durability.

NBC

TABLE 34A - MINIMUM METAL THICKNESS OF DUCTS, mm

Shape and Location of duct	Size of duct, mm	Galvanized Steel	Aluminum
All round ducts and enclosed rectangular ducts	350 or under over 350	0.33 0.41	0.30 0.41
Exposed rectangular ducts having a required clearance of up to 12 mm and serving single dwelling units	350 or under over 350	0.33 0.41	0.41 0.48
Other exposed rectangular ducts	350 or under over 350	0.41 0.48	0.41 0.48

(2) NBC Rectangular panels in plenums and ducts greater than 300 mm wide shall be designed to provide sufficient stiffness.

(3) NBC Where the installation of heating supply ducts in walls, floors and partitions creates a space between the duct and construction material, the space shall be sealed with non-combustible material at each end.

(4) NBC Ducts shall be securely supported by metal hangers, straps, lugs or brackets except that, where zero clearance is permitted, wooden brackets may be used.

(5) All round duct joints shall be lapped not less than 25 mm, shall have a snug fit without undue crimping or distortion and shall be taped with an approved material.

(6) Rectangular duct connections shall be made with S and drive cleats or equivalent mechanical connection and shall be taped with an approved material.

(7) NBC Trunk ducts shall not be nailed directly to wood members.

(8) NBC Branch pipes shall be supported at suitable spacing to maintain alignment and prevent sagging.

(9) NBC Combustible ducts in concrete slabs-on-ground that are connected to a furnace supply plenum shall be located not closer than 600 mm from that plenum, and not less than 600 mm from its connection to a riser or register.

(10) Ducts in or beneath concrete slabs-on-ground shall be watertight and shall be resistant to corrosion, decay and mildew.

G. FURNACE PLENUMS

(1) NBC The clearance of furnace plenums from combustible material shall conform to the requirements of the appropriate standards of B(4).

(2) NBC Where the plenum clearance required in (1) is 75 mm or less, the clearance between a supply duct and combustible material shall:

a) be equal to the required plenum clearance within 450 mm of the plenum, and

b) be not less than 12 mm at a distance of 450 mm or more from the plenum, except that this clearance may be reduced to zero beyond a bend or offset in the duct sufficiently large to shield the remainder of the duct from direct radiation from the furnace heat exchanger. (See Appendix A, NBC)

(3) NBC Where the plenum clearance required in (1) is more than 75 mm but not more than 150 mm, the clearance between a supply duct and combustible material shall:

a) be equal to the required plenum clearance within a horizontal distance of 1.8 m of the plenum, and

b) be at least 12 mm at a horizontal distance of 1.8 m or more from the plenum, except that this clearance may be reduced to zero beyond a bend or offset in the duct sufficiently large to shield the remainder of the duct from direct radiation from the furnace heat exchanger. (See Appendix A, NBC)

(4) Where the plenum clearance required in (1) is more than 150 mm, the clearance between a supply duct and combustible material shall:

a) be equal to the required plenum clearance within a horizontal distance of 1.0 m of the plenum, and

NBC b) be at least 150 mm within a horizontal distance between 1.0 and 1.8 m from the plenum, and

c) be at least 25 mm at a horizontal distance of 1.8 m or more from the plenum, except that this clearance may be reduced to 8 mm beyond a bend or offset in the duct sufficiently large to shield the remainder of the duct from direct radiation from the furnace heat exchanger. (See Appendix A, NBC)

H. AIR SUPPLY OUTLETS

(1) NBC Where a register is installed in a floor directly over a pipeless furnace, a double-walled register box with not less than 100 mm between the walls, or a register box with the warm-air passage completely surrounded by the cold-air passage, shall be permitted in lieu of the clearances listed in G(2), G(3) and G(4).

(2) A warm-air supply outlet shall be provided in each finished room in a dwelling unit. Where rooms are located adjacent to exterior walls, such outlets shall be located so as to bathe at least 1 exterior wall with warm air, except where it can be shown that other locations are satisfactory, and except in bathrooms, utility rooms or kitchens.

(3) NBC At least 1 warm-air supply outlet shall be provided for each 40 m^2 of floor surface area in unfinished basements serving dwelling units, located so as to provide adequate distribution of warm air throughout the basement.

(4) In crawl spaces used as warm-air plenums, adequate supply outlets shall be provided and located to direct the air towards the corners of the crawl space.

(5) NBC Ducts for outlets in crawl spaces used as warm-air plenums shall be not less than 1.8 m in length.

(6) NBC Except for pipeless furnaces and floor furnaces, the capacity of warm-air supply outlets serving dwelling units shall be not less than the design heat loss from the area served and shall not exceed 3 kW per outlet.

(7) NBC In basements and heated crawl spaces, the calculated heat gain from supply ducts and plenum surfaces may be considered in calculating the design heat loss.

(8) NBC Registers for warm-air supply outlets in garages shall be located not less than 1.2 m above the floor and shall be fitted with an automatic damper to prevent garage vapours from entering the heating system when air is not being supplied to the garage.

(9) NBC The temperature of supply air at the warm-air supply outlets shall not exceed 70°C.

(10) Except on permafrost soils, warm-air supply systems for residential buildings built on concrete slabs-on-grade shall be installed in the slab and shall be of the perimeter loop type or radial perimeter type.

(11) A warm air supply outlet shall be provided on the warm side of every entrance door separating heated space from unheated space.

(12) NBC The design of fittings for ducts shall conform to CSA B228.1, "Pipes, Ducts and Fittings for Residential Type Air Conditioning Systems," except that metal thickness requirements shall conform to those in Table 34A.

(13) NBC Warm-air supply outlets located in finished areas or on a furnace plenum or extended plenum shall be provided with a diffuser and adjustable opening.

(14) NBC All branch supply ducts that are not fitted with diffusers with an adjustable balance stop shall be supplied with an adjustable damper and fitted with a device to indicate the position of the damper.

I. RETURN AIR INLETS

(1) NBC The return-air system shall be designed to handle the entire air supply.

(2) NBC Except as provided in (3), return ducts shall be constructed of material having a surface flame-spread rating of not more than 150.

(3) NBC Where any part of a return-air duct will be exposed to radiation from the furnace heat exchanger or other radiating part within the furnace, parts of return ducts directly above or within 600 mm of the outside furnace casing shall be noncombustible.

(4) NBC Return air ducts serving solid-fuel furnaces shall be constructed of non-combustible material.

(5) NBC Combustible return ducts shall be lined with noncombustible material below floor registers, at the bottom of vertical ducts and under furnaces having a bottom return.

(6) NBC Spaces between studs used as return ducts shall be separated from the unused portions of such spaces by tight-fitting metal stops or wood blocking.

(7) NBC A vertical return duct shall have openings to return air on not more than 1 floor.

(8) NBC A public corridor or public stairway shall not be used as a return-air plenum.

(9) NBC The return-air system shall be designed so that the negative pressure from the circulating fan cannot draw furnace combustion products from joints or openings in the furnace or flue pipe.

(10) Return air inlets shall not be located in a garage, an enclosed service room or in a crawl space within which a furnace is installed.

(11) NBC Where warm air is exhausted into a garage, special provision shall be made for make-up air from the outside to compensate for this air.

(12) NBC Return air from a dwelling unit shall not be recirculated to any other dwelling unit.

(13) At least 1 return air inlet shall be provided on each storey and the basement of a dwelling unit. Each return shall serve an area having a design heat loss of not more than 18 kW.

(14) Provision shall be made for the return of air from all rooms by using louvred doors, installing a return duct inlet, or by other acceptable means.

(15) NBC Except for return-air plenums located within a dwelling unit, where a ceiling assembly is used as a plenum, the requirements of Part 6 of the NBC shall apply for such systems.

(16) Return-air inlets in finished areas shall be fitted with grilles.

J. STEAM AND HOT WATER HEATING SYSTEMS

(1) Every steam and hot water pipe shall be constructed of noncombustible material having adequate strength and durability.

(2) Insulation or other covering for steam or hot water pipes shall be noncombustible, except that combustible insulation may be used provided such insulation conforms to the requirements in Part 6 of the NBC for combustible pipe insulation.

(3) Clearance between steam or hot water pipes and combustible construction shall be at least 12 mm for steam or water temperatures greater than 90°C but not more than 120°C and at least 25 mm for temperatures over 120°C.

(4) The space around pipes passing through a wall or floor construction shall be fire stopped with noncombustible material. See Article 26C(5) for pipes passing through an air-vapour barrier.

(5) When pipes are run in a vertical shaft, the fire-resistance rating of the shaft shall conform to the requirements contained in Subsection 10K. Such shafts shall have a noncombustible lining where the pipes are not insulated.

(6) Steam and hot water pipes shall be designed to allow expansion and contraction with changes in temperature.

(7) For domestic hot water systems used for space heating, see 32B(4).

K. RADIATORS, CONVECTORS AND HEAT EXCHANGERS

(1) Every heat exchanger or unit heater using hot water or low pressure steam shall be installed with sufficient clearance to ensure that the temperature of any combustible material will not exceed its safe limit.

(2) Every steam or hot water radiator or convector attached to a wall or located in a recess or concealed space containing combustible material shall be provided with a noncombustible backing.

L. STOVES, RANGES AND SPACE HEATERS BURNING SOLID FUEL

(1) Stoves, ranges and space heaters burning solid fuel shall meet the requirements of Subsections 34B, 34C and 34D and CSA-B365.

(2) Stoves, ranges and space heaters burning solid fuel that are designed to operate with doors to the combustion chamber in an open position shall not be constructed or installed.

(3) NBC Space heaters burning solid fuel shall conform to ULC S627/CSA B366.2, "Standard for Space Heaters for Use with Solid Fuels".

(4) Stoves, ranges and space heaters burning solid fuel shall be installed in a room or space sufficiently large to permit accessibility to the appliance.

(5) NBC A stove, range or space heater burning solid fuel shall be connected to a chimney in accordance with Section 21.

(6) The minimum clearance between stoves, ranges or space heaters burning solid fuel and combustible material, whether or not such material is covered with noncombustible material such as plaster, shall conform to Table 34B, except that where protection is provided as described in Table 34C the clearance may be reduced in conformance to that Table.

(7) NBC Protection described in Table 34C consisting of sheet material spaced out from a wall, shall have at least 25 mm edge clearance along the bottom and 75 mm along the top. Protection spaced out from a ceiling shall have 75 mm edge clearance on at least 3 sides.

NBC

TABLE 34B. MINIMUM CLEARANCES TO COMBUSTIBLE MATERIAL FOR STOVES, RANGES AND SPACE HEATERS USING SOLID FUEL

Appliances	Minimum Clearance to Combustible Material, mm			
	Top	Sides	Rear	Front
Stoves and ranges without refractory lining	1200	—	900	1200
fire box side	—	900	—	—
other side	—	450	—	—
Stoves and ranges with refractory lining	1200	—	600	1200
fire box side	—	600	—	—
other side	—	450	—	—
Space heaters with at least a 50 mm air space between the outside of the fire chamber and the external casing to allow air circulation	1200	600	600	1200
Space heaters other than above	1200	900	900	1200

(8) NBC Clearances in this Subsection shall be measured from the outer surface of the appliance or of the insulation protecting the appliance to the combustible material, disregarding the protection applied over the combustible material. (See Appendix A, NBC)

(9) NBC A floor surface of combustible material beneath a solid fuel-fired stove, range or space heater, shall be protected by a floor pad conforming to (10) to (13), extending to at least 450 mm beyond the appliance on the firing side and the side where ashes are removed, and extending at least 200 mm beyond the appliance on the other sides.

TABLE 34C. MINIMUM CLEARANCES WITH PROTECTION, mm

NBC

Minimum Protection for Combustible Material	Percentage Reduction From Minimum Clearances in Table 34B	
	Sides and Rear	Top
6 mm asbestos millboard spaced out 25 mm by noncombustible spacers	50%	33%
0.33 mm sheet metal on 6 mm asbestos millboard	50%	33%
0.33 mm sheet metal spaced out 25 mm by noncombustible spacers	67%	50%
Solid brick wall spaced out at least 25 mm by noncombustible spacers	50%	NA
Ceramic tiles on 0.33 mm sheet metal backing spaced out 25 mm by noncombustible spacers.	50%	50%

(10) NBC A solid-fuel fired stove, range or space heater of a type in which flame or hot gases do not come in contact with its base and mounted on legs that provide a clear space of at least 100 mm in height shall be installed on a floor pad consisting of a layer of sheet metal at least 0.53 mm thick over 6 mm asbestos-cement board or other noncombustible material. (See Appendix A, NBC)

(11) NBC Except as provided in (12), a solid-fuel burning stove, range or space heater permanently supported to provide a clear space of at least 75 mm, shall be mounted on a floor pad consisting of a single course of 100 mm hollow masonry laid over 0.53 mm sheet metal in such a manner as to provide air circulation through the masonry layer. (See Appendix A, NBC)

(12) NBC Appliances described in (11) may be mounted on a floor pad of 0.53 mm sheet metal if 2 sheet metal plates at least 0.53 mm thick the same area as the appliance bottom are installed between the appliance bottom and the floor pad. The plates shall be placed at least 25 mm apart and spaced at least 25 mm from the appliance bottom and the floor pad by noncombustible spacers or by attachment to the appliance legs. (See Appendix A, NBC)

(13) NBC A solid-fuel burning stove, range or space heater mounted on legs that provide a clear space of at least 175 mm high may be mounted on a floor pad of 0.53 mm sheet metal if a sheet metal plate at least 0.53 mm thick and the same area as the appliance bottom is installed between the appliance bottom and the floor pad. The plate shall be spaced at least 50 mm from the appliance bottom and the floor pad by noncombustible spacers or by attachment to the appliance legs. (See Appendix A, NBC)

(14) NBC The clear distance between a solid-fuel burning stove, range or space heater and a fuel oil storage tank shall be at least 1500 mm.

M. FACTORY-BUILT FIREPLACES

(1) Factory-built fireplaces shall conform to the requirements of Subsections 34C and 34D.

(2) Factory-built fireplaces and their installation shall conform to ULC S610, "Standard for Factory-Built Fireplaces" or to ULC S611, "Standard for Factory-Built Free-Standing Fireplaces", or to CSA B365.

(3) Unless otherwise accepted, the minimum clearance requirements around factory-built fireplaces shall conform to Subsection 34L.

(4) Unless otherwise accepted, combustible floor material beneath factory-built fireplaces shall be protected in conformance with 34L(8).

N. FIRE PROTECTION FOR GAS AND ELECTRIC RANGES

(1) Except as provided in (2), a vertical clearance of at least 750 mm shall be provided above the elements or burners of electric and gas fired domestic ranges.

(2) Where cabinets located above the elements or burners referred to in (1) are noncombustible or are protected with asbestos millboard at least 6 mm thick covered with sheet metal not less than 0.33 mm, or by a metal hood with at least a 125 mm projection beyond the upper cabinets, the vertical clearance may be reduced to 600 mm.

(3) Combustible wall framing members within 450 mm of the area where the range is to be located shall be protected above the level of the heating elements by material providing fire resistance at least equivalent to 9.5 mm thickness of gypsum board.

O. OIL TANKS AND SUPPLY LINES

(1) Where an oil storage tank is located within the building envelope and on a combustible floor, a drip pan shall be placed under the tank in accordance with (2), and, where wood is used to support the tank, no support shall have a dimension less than 89 mm.

(2) The drip pan required in (1) shall be constructed of galvanized sheet steel having a thickness not less than 0.76 mm, extending at least 25 mm horizontally beyond the horizontal dimensions of the tank. The edges of the drip pan shall be raised at least 12 mm above the bottom of the pan, and the corners shall be sealed in a suitable manner.

(3) A fuel gauge fitted to an oil storage tank that is located within the envelope of a building shall be of a type approved by ULC for interior use.

(4) Where an oil storage tank is not located within a heated space, the pipe supplying oil to the building shall be constructed of black steel with a diameter of at least 50 mm, and shall extend at least 2 m within the heated space before a reduction in size is made.

(5) Shut-off valves controlled by fusible links shall be installed at the point where the oil supply pipe is reduced from the 50 mm size, just before the filter and close to the appliance, and at all connections with burners.

SECTION 35. ELECTRICAL FACILITIES

A. GENERAL

(1) This Section applies to all buildings, regardless of size.

(2) Electrical installations, including the service capacity of the installation and the number and distribution of circuits and receptacles shall meet the requirements of Subsection 35C and the appropriate provincial or municipal legislation or, in the absence of such legislation, shall conform to CSA C22.1, "Canadian Electrical Code, Part 1".

(3) Unless otherwise accepted, electrical facilities shall be provided for every building and every dwelling unit and public shared space in buildings containing dwelling units.

(4) Entrance switches, meters, service panels, splitter boxes, time clocks and other similar equipment shall not be located in any public area unless adequate precautions are taken to prevent interference with the equipment.

(5) Service panels shall have a minimum capacity of 100 A and shall be equipped with automatic breakers on all circuits.

(6) All electrical fittings, fixtures and associated wiring in walls containing an air-vapor barrier shall be installed so as to conform to Section 26.

(7) Wherever possible, wiring, receptacles and fixtures shall not be installed in or mounted on walls or ceilings that form part of the building envelope, unless the air-vapour barrier is located in the envelope so as to eliminate the possibility of punctures.

(8) Where electrical wiring is installed in insulated walls, the provisions of Clause 2-124 of CSA C22.1, "Canadian Electrical Code, Part 1" shall be applicable.

(9) Conduits containing electrical wiring and which penetrate the building envelope shall be sealed with materials compatible with the electrical wiring.

(10) Recessed lighting fixtures shall not be located in insulated ceilings unless the fixtures are accepted for such installations.

(11) Where a service panel is mounted on an insulated wall, it shall be surface mounted.

(12) Only copper conductors shall be used for branch circuits.

(13) Ground fault circuit interrupters shall only be installed in conformance with Clause 14-102 of CSA C22.1, "Canadian Electrical Code, Part 1".

B. LIGHTING OUTLETS

(1) An exterior lighting outlet with fixture controlled by a wall switch located within the building shall be provided at every entrance to buildings of residential occupancy.

(2) Except as provided in (3), a lighting outlet with fixture controlled by a wall switch shall be provided in kitchens, bedrooms, living rooms, service rooms, laundry rooms, workrooms, dining rooms, bathrooms, water-closet rooms, vestibules and hallways in dwelling units.

(3) Where a receptacle controlled by a wall switch is provided in bedrooms or living rooms, such rooms need not conform to the requirements in (2).

(4) Every stairway shall be lighted. Except as provided in (5), 3-way wall switches located at the head and foot of every stairway shall be provided to control at least 1 lighting outlet with fixture for stairways with 4 or more risers in dwelling units.

(5) The stairway lighting for basements or cellars that do not contain finished space nor lead to an outside entrance or built-in garage and which serve not more than 1 dwellling unit may be controlled by a single switch located at the head of the stairs.

(6) NBC A lighting outlet with fixture shall be provided for each $30m^2$ or fraction thereof of floor area in unfinished basements. The outlet nearest the stair shall be controlled by a wall switch located at the head of the stairs.

(7) A lighting outlet with fixture shall be provided in storage rooms.

(8) A lighting outlet with fixture shall be provided for an attached, built-in or detached garage or carport. Such outlet shall be controlled by a wall switch near the doorway where the fixture is ceiling mounted above an area normally occupied by a parked car; otherwise a switched lampholder may be used. Where a carport is lighted by a light at the entrance to a dwelling unit, additional carport lighting is not required.

(9) Every public or service area in buildings shall be provided with lighting outlets with fixtures controlled by a wall switch or panel to illuminate every portion of such areas. When other types of lighting are used, illumination equivalent to that shown in Table 35A shall be provided.

TABLE 35A - MINIMUM LIGHTING FOR PUBLIC AREAS

Room or space	lx	W/m^2 of floor area (Incandescent light)
Storage rooms	50	5
Service rooms and laundry areas	200	20
Garages	50	5
Public water-closet rooms	100	10
Public corridors and stairways	50	—
Service hallways and stairways	50	—
Recreation rooms	100	10

C. RECEPTACLES

(1) Except in kitchens, bathrooms, laundry rooms, water-closet rooms, service rooms and hallways, wall receptacles shall be installed in every finished room or area in a dwelling unit so that no point along the floor line of any usable wall space is more than 1.8 m from an outlet installed in the same room. Usable wall space shall be considered as wall space not less than 900 mm wide. Such space shall not include doorways, areas occupied by doors when fully opened, windows less than 300 mm above the floor, fireplaces or other permanent installations that would limit the use of the wall space.

(2) Where a switched receptacle is used in lieu of a lighting outlet and fixture as permitted in B(3), it need not be additional to the requirements in (1) provided only half of a duplex receptacle is switched.

(3) No fewer than 2 split duplex receptacles shall be provided over countertop work surfaces in kitchens in dwelling units. and in a dining area forming part of a kitchen. In addition, duplex receptacles shall be provided for each refrigerator space.

(4) A duplex receptacle shall be provided in every laundry room or area, service room or combined laundry-utility room. When grouped laundry facilities are provided, sufficient outlets shall be provided to serve adequately the equipment to be installed by the building owner or tenants.

(5) Except for stairs leading to unfinished basements or cellars, no point in a hall or stairway in a dwelling unit shall be more than 4.5 m from a receptacle.

(6) Special purpose outlets or cables shall be provided to the space where an electric range or clothes dryer is to be installed.

(7) Public corridors and public stairs shall have at least 1 duplex receptacle for each 10 m length or fraction thereof.

(8) A weatherproof duplex receptacle, conforming to Clause 26-706 of CSA C22.1, "Canadian Electrical Code, Part 1", shall be provided for each dwelling unit on the outside of the building and convenient to a parking area. The receptacle shall be controlled by a switch that is installed inside the building.

D. EMERGENCY LIGHTING AND ALARMS

(1) Emergency lighting shall conform to Subsection 9 K.

(2) Circuit wiring for smoke and other alarms shall conform to Section 10.

SECTION 36. GARAGES AND CARPORTS

A. SCOPE

(1) This Section applies to garages and carports serving not more than 1 dwelling unit.

(2) The construction of a garage or carport shall conform to the requirements for other buildings in this Standard except as provided in this Section.

(3) Garage door requirements shall conform to the appropriate requirements in Subsection 6 G.

(4) Insulation of heated garages shall conform to the requirements in Section 26.

B. GENERAL

Where a roofed enclosure used for the storage or parking of a car or cars has more than 60 per cent of the total perimeter enclosed by walls, doors or windows, the enclosure shall be considered a garage.

C. FOUNDATIONS

(1) Ecxept as permitted in this Subsection, foundations conforming to Sections 12 and 15 shall be provided for the support of carport and garage superstructures including that portion beneath garage doors.

(2) In clay-type soils subject to significant movement with a change in soil moisture content, the foundation depth of carports or garages connected to a dwelling unit by a breezeway shall be approximately the same depth as the main building foundation. Where slab-on-grade construction is used, a construction joint shall be provided between the main building slab and the garage or breezeway or carport slab. Except as provided in Section 12, foundations for attached unheated garages or carports shall be below frost level.

(3) Detached garages of less than 50 m^2 floor area and not more than 1 storey in height may be supported on wood mud sills provided the garage is not of masonry or masonry veneer construction.

(4) Piers for the support of carport columns shall extend not less than 150 mm above a grade. Such piers shall project not less than 25 mm beyond the base of the column but in no case be less than 190 mm in size.

D. WALLS AND COLUMNS

(1) Interior finish need not be applied to garage and carport walls.

(2) Columns for garages and carports shall conform to Section 17, except that 89 mm by 89 mm wood columns may be used.

(3) Garage or carport walls and columns shall be anchored to the foundation to resist wind uplift in conformance with Subsection 23 F, except that where a garage is supported on the surface of the ground, ground anchors shall be provided to resist wind uplift.

E. DIMENSIONS

(1) Garages and carports shall have a clear inside length of not less than 6.1 m.

(2) Garages and carports shall have a clear inside width of at least 3.05 m for single car parking, except that where a door in a side wall of a garage swings into the garage or where there is a doorway in a wall between the house or apartment building and the carport, the inside width shall be at least 3.35 m. At least 2.5 m additional clear width shall be provided for each additional car. Where a garage or carport is divided by columns or walls, the dimensions of each section shall conform to the preceding requirements. Measurements shall be taken 200 mm from the door.

(3) Door heights shall conform to 6 G(2).

SECTION 37. ELEVATORS

A. GENERAL

(1) In addition to the requirements for elevators in Parts 3 and 6 of the NBC, the requirements of this Section shall apply to all buildings regardless of size.

(2) At least 1 elevator shall be accessible to and usable by persons in wheelchairs at the entrance level and all levels normally used by the occupants.

B. NUMBER OF ELEVATORS

(1) Except as provided in (2) and (3), at least 1 elevator shall be provided in every building which has dwelling units above the third storey and in buildings in which the vertical distance from the ground level at the main entrance door and floor of the uppermost dwelling unit exceeds 7.3 m. Where there are exterior stairs or a platform at the main entrance, such vertical distance shall be measured to the bottom of the stair or platform.

(2) At least 2 elevators shall be provided in buildings which have more than 3 dwelling units on the seventh or higher storey, or where the vertical distance between the main entrance door and the floor of the uppermost dwelling unit exceeds 15.2 m. Where there are exterior stairs or a platform at the main entrance, such vertical distance shall be measured to the bottom of the stair or platform.

(3) At least 1 elevator shall be provided in every building which is specifically designed to accommodate elderly persons above the second storey, or where the vertical distance from the ground level at the main entrance door to the uppermost floor level designed to accommodate elderly persons exceeds 4.5 m. Where there are exterior stairs or a platform at the main entrance, such vertical distance shall be measured to the bottom of the stair or platform.

C. ELEVATOR CAPACITY

(1) The elevators shall have a carrying capacity of not less than 7 per cent of the total building occupant load in 5 min.

(2) The total building occupant load shall be calculated on the basis of 2 persons per bedroom or combination room with sleeping facilities excluding the ground elevator terminal floor.

(3) At least 1 elevator in each building with dwelling units on 7 or more floors shall have a minimum capacity of 900 kg.

D. ELEVATOR SPEED

(1) Elevator speeds shall be designed to provide a maximum time interval of 80 s for 2 or more elevators. For single elevator installations the maximum time interval shall be 150s.

(2) Elevator speed shall be not less than 1 m/s for buildings of more than 10 storeys in building height.

E. CONTROLS

(1) In 1-,2- or 3-car installations, the system shall be not less than simplex, duplex or triplex down collective control, respectively.

(2) Hydraulic elevators shall have full electric control and operation.

(3) Where an elevator is required to accommodate physically handicapped persons, the uppermost button in the elevator cab control panel shall be not more than 1.5 m above the elevator cab floor.

SECTION 38. PAINTING

A. GENERAL

(1) This Section applies to all buildings, regardless of size.

(2) Paints, other protective coatings and materials for mixing and thinning shall conform to appropriate specifications of the Canadian Government Specifications Board or shall be of the type acceptable to the authority having jurisdiction.

(3) Surfaces that are to be finished shall be free from dirt, grease, asphalt or other foreign material that may harm the finish. If a wooden surface is to be painted, a prime coat shall be applied to it, exposed open defects shall be filled with putty or other suitable filler and knots or other resinous areas shall be sealed with suitable knot sealer or aluminum paint.

(4) Paints or other finishes shall be applied at at temperature of not less than 5°C.

(5) Paint or other protective coatings shall not be applied to wood having a moisture content greater than 19 percent, or whose surface is wet. Paints and other protective coatings shall be applied according to the manufacturer's instructions.

B. EXTERIOR PAINTING

(1) Except for cedar and redwood, all exposed exterior materials subject to deterioration in their unprotected state, such as wood (including the tops and bottoms of wood doors), hardboard and ferrous metal shall be stained, painted or otherwise suitably protected.

(2) Exterior metal that is to be painted shall receive at least 1 coat of suitable primer plus 2 finish coats of exterior paint.

(3) Where the back face of the cladding is not ventilated, paint used on cladding shall be of a vapour-permeable type.

C. INTERIOR PAINTING

(1) Bathrooms, kitchens and laundry areas other than in unfinished basements shall be painted or otherwise suitably treated to resist damage from moisture, except that plaster need not be painted.

(2) In habitable rooms, vestibules and halls a suitable finish shall be applied to gypsum board without factory applied decorative finish, wood panelling, trim, cupboards, shelving, sash and window frames, door and door frames.

(3) A suitable finish shall also be applied to handrails and stairs to basements, cellars or attics.

(4) Wood floors and stairs between floor levels with habitable rooms shall be treated with at least 1 coat of sealer plus 1 coat of wax or other suitable finish.

(5) All structural steel surfaces shall be painted to resist corrosion.

(6) See Subsection 26E regarding the use of liquid applied coatings as air-vapour barriers.

SECTION 39. WALKWAYS, DRIVEWAYS AND PARKING AREAS

A. PARKING AREA

(1) This Section applies to all buildings, regardless of size.

(2) Except when equivalent parking is provided in garages or carports, a parking area for the storage of at least 1 car per dwelling unit shall be provided for buildings containing 1 or 2 dwelling units, or provision shall be made on the property for suitable access to and a space for a future parking area, garage or carport.

(3) Except when equivalent parking is provided in garages or carports, at least 1 parking space for each dwelling unit in a building containing more than 2 dwelling units shall be provided on the property. Such parking areas shall not be located so as to impair the view from living rooms, entrances or front yards and shall be at least 6 m away from windows for living rooms, dining rooms, bedrooms or kitchens below grade.

(4) Parking areas shall be at least 6.1 m long and 2.5 m wide with a gradient and cross slope of not more than 60 mm/m and a minimum cross slope of 15 mm/m where the gradient is less than 15 mm/m.

(5) Depending on the angle of parking, sufficient additional space shall be provided to allow for turnout. This space shall be at least 5.5 m wide, measured between rows of parked cars or from 1 row to the limit of the paved area. This space may be reduced when permitted by the authority having jurisdiction.

(6) When parking areas are surfaced, the base and topping shall conform to the appropriate requirements in B for driveways.

B. DRIVEWAYS

(1) A space for a driveway shall be provided to a garage, carport or parking area. Where a garage or carport is provided, a driveway shall be installed to connect with the paved or travelled portion of the street or lane.

(2) Driveways serving not more than 4 dwelling units shall have a minimum width of 2.5 m, except that combined walkway-driveways shall be at least 3 m wide. Two paved ribbons may be used for driveways serving a single dwelling unit provided the ribbons are at least 600 mm wide and are spaced 1.5 m o.c..

(3) Driveways serving more than 4 dwelling units shall be at least 2.5 m wide for 1-way driveways and at least 5.5 m wide for 2-way driveways.

(4) Driveways shall have a maximum cross slope of 60 mm/m and a minimum cross slope of 15 mm/m where the gradient is less than 15 mm/m.

(5) Driveways shall not be constructed on unconsolidated filled ground.

(6) The base for driveways shall be crushed stone, gravel or other coarse clean granular material.

(7) The driveway surface shall consist of stone chips, crushed stone, gravel, asphalt concrete or portland cement concrete.

(8) When the driveway surface consists of stone chips, gravel or crushed stone, the base shall be at least 150 mm thick and the surface material shall be not more than 20 mm size.

(9) When the driveway surface consists of asphalt concrete, the base material shall be at least 100 mm thick and the compacted thickness of the concrete at least 40 mm thick.

(10) When the driveway surface consists of portland cement concrete, the base shall be at least 120 mm thick and the concrete at least 75 mm thick, except that the base may be omitted where the ground is solid rock, compacted sand or gravel provided the concrete is 120 mm thick. Concrete shall have at least 20 MPa compressive strength after 28 days and shall have air entrainment of 5 to 7 per cent. Construction joints shall be spaced not more than 3 m apart.

(11) Waterproofing membranes applied to roofs subject to vehicular traffic or used for parking shall be applied to the roof in a manner that will permit differential movement between the surfacing materials and the roof deck without damaging the membrane.

(12) Waterproofing membranes in (11) shall be protected against damage during construction by means of a layer of material of sufficient strength to prevent crushing under traffic loads. The wearing surface shall conform to the requirements in (9) and (10).

C. WALKWAYS

(1) Every entrance to a building except a patio door shall be served by a walkway or a system of walkways, except that not more than 2 walkways need be provided to a building. A combined walkway-driveway may be used where the building exit serves not more than 2 dwelling units.

(2) A main walkway shall be provided from the street to the principal entrance of a building on each property.

(3) Where a garage, parking area or driveway serves a building containing more than 2 dwelling units, a main walkway shall be provided between such building and garage, parking area or driveway.

(4) All other walkways may be secondary walkways leading to main walkways or to the street.

(5) The minimum width of walkways shall conform to Table 39A.

TABLE 39A - WALKWAY WIDTHS

Type of Walkway	Maximum No. of Dwelling Units Served	Minimum Walkway Width, mm
Main walkways	4	750
	8	900
	16	1 200
	more than 16	1 500
Secondary walkways	4	600
	8	750
	16	900
	more than 16	1 200
Column 1	2	3

(6) Walkways shall have a maximum gradient of 100 mm/m and a maximum cross slope of 60 mm/m. When the gradient is less than 15 mm/m the minimum cross slope shall be 15 mm/m.

(7) Where steps occur in walkways, there shall be at least 2 risers at any one location. Such steps shall have a rise of not less than 100 mm nor more than 180 mm and a minimum run of 300 mm. The product of the run and the rise shall not exceed 54000. Steps shall be as wide as the walkway and shall be provided with a handrail on one side when there are more than 3 risers.

(8) Walkways shall not be constructed over unconsolidated filled ground.

(9) Walkways shall consist of one of the following:

a) 75 mm of fine gravel or crushed stone, or

b) hard burned shale, clay or concrete brick, or

c) 40 mm thick smooth, durable flagstone, precast concrete, or

d) 100 mm thick portland cement concrete of at least 20 MPa strength after 28 days, where the walkway has contraction joints spaced apart not more than 1 1/2 times the walkway width, or

e) 40 mm thick asphalt concrete over a granular base at least 100 mm thick, or

f) A raised wood boardwalk, where the wood members have a minimum dimension of 38 mm and the wood is suitable for exterior use, such as cedar, or the wood is treated to prevent deterioration.

(10) Where a roof is used for pedestrian traffic, provision shall be made to allow for differential movement between the walking surface and the roof deck in conformance with B (11).

(11) The waterproofing membrane shall be protected against damage during construction in conformance with B (12), and the walking surface in (10) shall conform to the requirements in (9).

SECTION 40. SITE IMPROVEMENT

A. GENERAL

(1) This Section applies to all buildings, regardless of size.

(2) An site survey of the building property, including pertinent data on immediate surroundings, shall be prepared as required by the authority having jurisdiction before commencement of any building. The survey shall include data relating to both man-made and natural existing characteristics, such as property lines, easements, roads, buildings, utility lines, topography, surface soils, rock outcroppings, vegetation, natural drainage patterns, and any other pertinent information.

(3) A plan of the proposed site development for the entire building site shall be prepared as required by the authority having jurisdiction, based on the site survey required in (2). The site development plan shall include details of the configuration of the proposed building, site grading and drainage, vehicular and pedestrian circulation, and measures proposed for the protection of plants and rehabilitation of vegetation of all disturbed areas.

(4) Existing site elements, such as established natural drainage corridors, vegetative cover and fertile soil, shall be protected and reutilized wherever possible.

(5) Siting of proposed structures shall reflect adequate consideration of protection from prevailing winter winds, 100-year flood plain levels, and prevention of undesirable snow accumulation at critical points such as exits, entries and mechanical vents.

(6) The building site shall be kept stable from soil erosion, during and after construction.

B. PROTECTION OF EXISTING VEGETATIVE COVER

(1) Every effort shall be made to protect and permit the retention of existing vegetation.

(2) Near and above the approximate northern limit of trees, the existing on-site tundra vegetation shall be protected from all unnecessary construction damage Surface clearing and rough grading operations shall be limited to only those areas deemed essential to the project.

(3) Where fill is required around existing trees, it shall be of a porous nature, such as sand or a sandy loam. The depth of this cover shall not exceed 150 mm over a maximum of 50% of the total root area, where the outer periphery of branch spread is taken as an indicator of root area. Where heavier soils such as clay loam are used, the depth of cover shall not exceed 100 mm and such cover shall be kept at least 300 mm away from the tree trunk.

(4) Where a greater depth of fill is required, the area above the entire root system shall be brought to within 150 mm of the finished grade, with a porous fill of crushed, broken or small stones, so as to permit the tree roots to breathe.

(5) The fill required in (4) shall be kept at least 300 mm away from the tree trunk by means of a drystone, unmortared brick, block or equally porous and durable wall. The wall shall extend to the height of the finished grade.

(6) Where it is intended to use a grass type of ground cover, the porous stone fill required in (4) shall be blinded at its surface with a soil filter blanket, such as perforated tar paper, and then covered with 150 mm of organic soil. Where no vegetative cover is intended, a cover fill with suitable porous surface material such as clean river gravel or bark chips, shall be used.

(7) Where the grading operation lowers the grade around trees that are to be retained, the earth around such trees shall be undisturbed for a radius from the tree trunk equal to approximately 2/3 of the branch spread. Where such a change of level exceeds 250 mm, the soil around such tree root areas shall be contained by a wall or by a slope that is maintainable and not prone to erosion, extending down to the proposed grades.

C. GRADING AND TOPSOIL

(1) See Subsection 14F for surface drainage.

(2) The alteration of existing grades and vegetative cover shall be kept to an absolute minimum.

(3) Grading solutions shall be directed at controlling surface runoff water without altering or compounding drainage patterns on adjacent lands.

(4) Construction and other debris such as tree stumps or abandoned oil drums, shall be removed from the site before grading or subsequent landscape rehabilitation operations are begun.

(5) All proposed grade transitions, including drainage swales, shall be gradual. Gradients exceeding 4 in 10 shall be suitably landscaped or retained to prevent soil erosion, excepting existing slopes which are adequately retained by trees, shrubs, turf, tundra vegetation or rock outcroppings.

(6) Disturbed areas of the site shall be restored to approximate original drainage patterns and grades. Proposed lawn areas shall be subgraded to within 100 mm of finished grade. Low areas shall be filled and compacted.

(7) Where topsoil for grass or tundra vegetation is specified and available, it shall be reasonably free of stones and capable of supporting good agricultural growth. It shall be applied and spread in a uniform layer to a minimum compacted depth of 100 mm over the areas disturbed by the building and grading operations.

(8) Where topsoil is unavailable, the most suitable locally available soil capable of supporting local vegetative growth shall be used and applied as in (7).

D. LAWN AREAS

(1) On areas of the building site on which sodding or seeding is specified, a suitable mixture of low nitrogen, high phosphorous content commercial fertilizer shall be applied evenly and cultivated to the full depth of the top soil at the rate recommended by the manufacturer.

(2) On areas of the building site on which seeding is specified, a Canada No.1 mixture grade of permanent lawn grass species known to be successful in the locality shall be applied at the rate of 2 to 2.5 kg/100 m^2. The area shall then be lightly raked, rolled with a light turf roller and watered until the moisture has penetrated to a depth of at least 25mm.

(3) On areas of the building site on which sodding is specified, sods not less than 20 mm nor more than 40 mm thick, containing a good percentage of permanent lawn grass species common to the locality shall be carefully laid over topsoil which has been cultivated and raked level. Sods shall be laid evenly with no overlapping and with tightly closed joints. Immediately after sodding the ground shall be thoroughly watered to ensure a moisture penetration of 100 to 125 mm. After the soil has dried out sufficiently so that its structure will not be damaged, it shall be rolled with a medium weight roller or tamped to provide a uniform surface.

(4) In permafrost areas where lawn grass is either impractical, unspecified, unavailable or intolerant of local climatic conditions, all slopes subject to erosion, such as raised granular building foundation pads, shall be stabilized with local dry stone rip-rap or equally suitable means. Other disturbed portions of the site having slopes of 3 in 10 or lower, shall be rolled and raked smooth to permit natural re-vegetation of local ground cover plants to occur.

(5) Where tundra ground cover plants are specified, a balanced fertilizer such as 20.20.20 shall be applied at the rate of 1 to 1.5 kg/100m^2. The area shall then be rolled, lightly raked and watered just prior to and immediately following the transplanting operation. Each transplant shall be firmly set into the prepared soil, and final watering shall ensure a moisture penetration of 100 mm.

E. PLANTING OF TREES, SHRUBS AND GROUND COVER

(1) Where planting of trees and shrubs is specified, the requirements of (2) to (8) shall apply.

(2) Plant material shall conform to the "Guide Specifications for Nursery Stock" of the Canadian Nursery Trades Association. Dried out plants shall not be used.

(3) Pits for tree planting shall be at least 600 mm deep and have a diameter of at least 150 mm beyond the root spread, or a diameter not less than 12 times the diameter of the tree at 300 mm above grade.

(4) Pits for shrub planting shall be at least 400mm deep and have a diameter at least 150mm beyond the root spread.

(5) Approximately 3 kg of bone meal and 3 kg of activated sludge shall be thoroughly mixed with each cubic metre of top soil.

(6) Each plant shall be thoroughly watered when the hole is 2/3 filled with soil. After final backfilling and watering, the soil shall be left at least 25 mm lower than the surrounding ground level, forming a shallow depression to collect rainwater.

(7) All planted trees with a caliper of 75 mm and over, measured at 300 mm above grade, shall be suitably guyed by at least 3 wires encased at the trunk in water hose or other protective material. Smaller trees shall be supported by a wood stake and suitably protected to prevent damage to the tree.

(8) Pruning of planted material and existing trees shall be done in accordance with good local practice.